MURRAY DARLING BASIN

SUBMISSION

GUIDE TO THE PROPOSED BASIN PLAN

Water Planning and the Environment

Murray Mouth 1949

Murray Mouth 2001

INTERIM REPORT DRAFT

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This submission is based on 3 parts:

Section 1 **A Dry Continent - History of Water Planning**

Section 2 **Murray Darling Basin Authority – Guide to the proposed Basin Plan**

Section 3 **Attachment A – Lower Lakes, Coorong Advice to the Murray Darling Basin (May 2010)** ***previously submitted***

Section 4 **Analysis of risk, opportunities and solutions – Delivery of Environmental flows (to be provided)**

Overview

"The Water Act 2007 and the proposed Murray Darling Basin Plan build on a long history of water reform in Australia. For more than a decade, the Australian Government and Basin States have been working together to restore the environmental health of the Basin and redress past decisions"

"the Authority is acutely aware of the urgency and importance of restoring the ecological health of the Basin".

"Twenty out of twenty three catchments in the Basin are in 'poor' to 'very poor' ecosystem health."

"the combination of drought and historic diversions mean that there have been no significant flows through the Murray Mouth since 2002."

(Extract: Murray Darling Basin Authority Guide to the Proposed Basin Plan: Volume 1)[1]

The Murray Darling Basin Plan will reshape Australia's food bowl, permanently reversing Australia's long term economic investment and resource planning, developed by previous generations.

At the heart of the proposed changes, are social and political responses, to a number of perceived issues.

1. the Murray River is dead and dying and there are imperatives to restore the ecological health of the Basin

2. Flows of an additional 'minimum 2000 GL' out the Murray Mouth will result in a 'healthy' river

3. the Murray Mouth, Lower Lakes and Coorong ecological problems have resulted in over extraction of waters from the Murray River

4. the Murray Darling Basin waters are over allocated

5. re-plumbing the Basin can drought proof the nation

6. returning water to the environment will give irrigation communities more certainty

In assessing the merits of these statements and developing a sustainable approach to managing the waters of the Murray Darling Basin, we need to carefully explore the issues. This document may encourage a broader understanding of the issues surrounding development of the Basin Plan.

[1] MDBA – Guide

(map MDBC archive website)

The Murray Darling Basin covers 14 % of Australia's land area with the total basin river catchments extending to 10.06 million km2 [2]

"Agricultural economic output from the Basin is around AUD $23 billion. AUD $10 billion of this is from agriculture, equivalent to almost one third of the value of Australia's total annual agricultural output." [2]

"The Basin contains 72% of Australia's total area of irrigated crops and pastures. The important irrigation industries are dairy, cotton, rice and horticulture. The value of irrigated production from the Basin has been estimated to be worth $3-$4 billion at the farm gate, with an estimated four fold multiplier in value through processing beyond the farm gate.[3]

"The Murray Darling Basin is home to 40% of all Australia's farms, producing wool, cotton, wheat, sheep, cattle, dairy produce, rice, oil-seed, wine, fruit and vegetables for both the domestic and overseas market. As Australia's most important agricultural region, the Basin produces one third of Australia's food supply and supports over a third of Australia's total gross value of agricultural production." [4]

Three quarters of Australia's irrigated crops and pastures are grown in the Basin.
The Basin's most valuable resource is water. The water in the Murray-Darling Basin system comes from a very small percentage of the Basin area; mainly along the southern and eastern rim. Almost 68% of the vast 'catchment' area contributes very little or no regular run-off to the river.[4]

The three longest rivers in Australia all run through the Murray Darling Basin.
These are: the Darling River (2740km approx) the River Murray (2530km approx) and the Murrumbidgee (1574km approx)

Food production in the Murray, Murrumbidgee, Lachlan and Lower Murray Darling Basins directly employ 30,000 people – six times greater than the national average for agriculture".[5]

2 Water for the Future
3 MDBC
4 Discover Murray River
5 RAMROC

EXECUTIVE SUMMARY

The waters of the Murray Darling Basin (MDB) have been subject to significant planning and investments by Governments and the community, in addressing the social, economic and environmental needs of Basin.

Without prior Government **investment in securing water supplies** for communities and industries through the building of **major storage dams**, the **Murray River would have gone dry** during this **current extended drought.**

Since the initial Murray Darling Basin agreement in 1915, water planning has undergone substantial change which has placed new levels of importance, on the needs of the environment.

Up until 1979, the largest Basin States of New South Wales and Victoria had 5/13th each of Murray River Water sharing arrangements. South Australia, was entitled to 3/13th, being the smallest basin state (6.7% of the basin) with minimal contribution to river inflows. During proposals to build a new storage dam at either Chowilla or Dartmouth prior to 1979, South Australia held its right of veto and negotiated an increased share of the Basin Water to equal NSW and Victoria. (At the time it was identified that Chowilla site was unsuitable due to regional salinity issues).

In determining additional needs for the environment under the new MDB Plan, it is important to understand what has been achieved in the past, before appropriate decisions can be made about further adjustments.

A range of environmental concerns have evolved through the 1990's to the current date, under the auspices of the Murray Darling Basin Commission and its replacement, the Murray Darling Basin Authority.

Planning for the environment has been achieved under the Murray Cap on extractions (1997), the National Water Initiative (NWI) (2004) (which developed stronger environmental provisions delivered through the Basin's Water Sharing Plans), the Living Murray Initiative and a range of other environmental programs. The Living Murray Initiative saw an investment of $700 million to recover 500 GL of water, for 6 icon sites on the Murray River. (Note: environmental benefits derived under the Living Murray or National Water Initiative water plans have not been assessed due to drought)

A key driver of change was to the need to enhance environmental flows to wetlands, provide additional flows to meet environmental concerns in the Lower Lakes, Coorong and Murray Mouth and to address concerns of dryland salinity and its modeled risk to the Murray River.

The Murray Darling Basin Commission's Salinity Audit (1999) provided salinity predictions for 'all major river valleys in the Basin for the next 20, 50 and 100 years'. [6]

This Audit was 'complimented by a CSIRO publication that assesses the ability of our agricultural land and grazing industries to reduce the predicted impact – Effectiveness of

[6] MDBC Website: Salinity

Current Farming systems in the Control of Dryland Salinity' (John Williams, Glen Walker & Mat Gilfedder – CSIRO). [7]

This report's executive summary, on farming systems and the control of dryland salinity, identifies that the 'problem', (ie dryland salinity) 'is not under control and therefore the risks of land impacted by dryland salinity, would rise from 1.8 million hectares to 15 million hectares'.

> 'projections for the town of Morgan (SA) a key location used to monitor the effect of salinity in the lower parts of the Basin in South Australia, illustrate the problem. Here the salinity of the River Murray is expected to increased by a further 240 EC units (micro/Siemens/cm) over the next 50 years'. This will bring salinity in this part of the river close to the World Health Organisation's limit of 800 EC for desirable drinking water..' [8]

The World Wildlife Fund convened the Wentworth Group of Concerned Scientists. Their Blueprint for a National Water Plan (July 2003) sought 'at least' 100 GL each year for five years – a total of 500 GL. (*aspects from the Wentworth Group's Blueprint for a National Water Plan, are also consistent with policy development under the National Water Initiative).*

Key documents that have **underpinned environmental planning** for the **Murray River,** specifically the **Living Murray Initiative**, include:

- Report of the River Murray Scientific Panel on Environmental Flows. River Murray – Dartmouth to Welling and the Lower Darling River (June 2000) (*"SRP Report)*
- Snapshot of the Murray Darling Basin River Condition. (September 2001) *("Snapshot")*
- Independent report of the Expert Reference Panel on Environmental Flows and Water Quality Requirements for the River Murray System. ("ERP Report)

Following differing views on the health and condition of the Murray River, a report was commissioned by Murray Irrigation Limited, to **review the science behind the Living Murray Initiative.**

In the report, 'a Review of the Science behind the Living Murray Initiative' – Ecology Management Pty Ltd (October 2003), the executive summary includes the following observations on the reports underpinning the Living Murray Initiative. These include:

- **("SRP report")** – Ecology Management Pty Ltd stated:
  - "expert panels do not supersede the need for basic data collection" & "outputs from the panels can vary significantly depending on their membership, their Terms of Reference' and the timing of their conduct"
  - "The River Murray Scientific Panel identified 22 activities which threaten river floodplain health. 7 of those relate to flow and only 2 related to reduced volumes of water"
- **("Snapshot")** – Ecology Management Pty Ltd stated:
  - "the Snapshot represents a concise summary of Basin specific data drawn from The Assessment of River Condition ("ARC", Norris et al 2001) plus some use of specific river data drawn from several sources". Ecology Management acknowledges the "scale of information, the readable nature

[7] MDBC Salinity Audit
[8] MDBC/CSIRO

and that the report acknowledges it own limitations", but goes on to say……

  - "The limitations are substantial and relate mainly to lack of data, either with respect to particular aspects of the environment or in terms of spatial or temporal distributions of data points, the methods by which data has been modeled or condensed and the inability to place a relative weight on the various causes of impact"
- **("ERP Report)** – Ecology Management Pty Ltd stated:
  - "the ERP report (Jones et al 2002) is probably the most influential but least scientific repot with respect to environmental flows in the River Murray. It is influential because it was submitted to the highest decision making body – the Ministerial Council, prior to being reviewed by either public or peers. It is the one which relies most on expert opinion and hydrological models, models which do not cover floodplain *per se*."

The Federal Government House of Representatives Standing Committee on Agriculture, Fisheries and Forestry, investigated the Murray River in an **Interim** Report titled - Future Water Supplies for Australia's Rural Industries and Communities. (2004) The committee's conclusions include:

- '*given the magnitude of what is at stake, the potential economic and social dislocation that could emerge from any decision to allocate water to increased river flows, the* ***Committee is of the view that there is insufficient certainty in the science underpinning the Living Murray Initiative'.***
- '*The level of disagreement between the scientists is itself cause for concern.' 'The Committee asks 'would scientists promoting new treatments or pharmaceuticals to address the health problems of human beings be so cavalier in terms of paucity of data and testings as appears to the be the case with the health of the Murray Darling Basin'*
- *'The Committee is aware of the historical evidence for extreme variability with the flow regimes of the River Murray and has sought, and is still seeking, comprehensive historical data on river flow to guide its understanding of the River's needs.'*
- *'the Committee is also of the view that greater emphasis should be placed on environmental management regimes which require non-flow actions.'*
- *Finally, the Committee believes that the science behind the Living Murray must be undertaken free of agendas – that in order to protect the integrity of the process, all scientific research be undertaken by independent scientists untainted by advocacy or rent seeking".*

During this period, the health of the Murray River had reached a new political status. The River's health was sensationalized and this appeared to be reminiscent of the dire predictions associated with earlier salinity reports and predictions. Politics at the time appear to have 'toned down' the House of Representative Standing Committee's final report, which is perhaps reflective of the political positions at the time.

It is important to recognize, that the claims for more water for the environment, have constantly been amended upwards.

The Federal Government invested in the Living Murray $700 million , which proposed 500 GL of water recovery for six icon sites along the Murray River. (Note: Water recovered under the Living Murray has not been utilized, monitored or assessed, due continued drought conditions commencing in the North from 1997 and more generally across the Basin during the period 2001-2010).

At this period, some environmental advocates had sought a broader target of 1500 GL, to restore the 'dead and dying' Murray River.

In June 2010, the Wentworth Group of Concerned Scientists in Association with Prof R. Quentin Grafton, Ian Kowalick, Prof Chris Miller, Tim Stubbs, A/Prof Fiona Verity, A/Prof Keith Walker, identified that:

> 'the best-available science suggest there is a substantial risk that a working river will not be in a healthy state when key system level attributes of the flow regime are reduced below two-thirds of their natural level. To achieve a level of two-thirds natural flow in all the catchments of the Basin the environment's share of existing Cap on diversions would need to be increased by approximately 4,400 GL (ie. 4,400 GL long-term Cap equivalent).
>
> This represents a reduction of approximately 40% of the current Cap on diversions. This implies that the Sustainable Diversion Limit for the Basin should be defined in a manner that is equivalent to a Cap of approximately 7,100 GL.'[9]

The Murray Darling Basin Authority (MDBA) released the Guide to the Proposed Basin Plan on 8th October 2010. The Guide identified the amount of water needed for the environment as between 3,000 GL and 7,600 GL

In order to minimize social and economic impacts, the MDBA has identified the following targets as the preferred range for restoring the health of the Murray Darling Basin.

1. 3000 GL - recovery of water for the environment
2. 3500 GL – recovery of water for the environment
3. 4000 GL – recovery of water for the environment

The figures identified in this range are to optimize economic, social, and environmental outcomes and to recognize the physical constraints of the Basin, ie where water could be sourced.

The MDBA proposals set to 'move the goal posts' again, when significant reforms achieved under the National Water Initiative, have not even been determined or monitored, due to the severity of the 'Millennium drought' (2001-2010).

Underpinning the planning decisions of the MDBA are a range of scientific documents.

Key documents include:

- 1999 Murray Darling Basin Commission's *Salinity Audit* and the complimentary report – *Effectiveness of Current Farming systems in the Control of Dryland Salinity*
- CSIRO - *Sustainable Yield Report*
- Murray Darling Basin Ministerial Council – *Sustainable Rivers Audit*

Following the release of the MDBA Guide to the proposed basin plan, basin communities have expressed strong concerns in relation to the MDBA's reliance on existing source data and the findings of specific reports, generated during a major drought event.

[9] Wentworth Group in Association – Sustainable Diversions in the Murray Darling Basin

In 2010, the reduced prominence of salinity, reflects a revised attitude to the risks, since the modeled predictions on rising groundwater, both in the MDB Salinity Audit and in the broader National Salinity Audit 2000. The audits at the time, led to the $1.4 billion investment in the National Action Plan for Salinity and Water Quality funded under the Natural Heritage Trust.

Salinity issues during the 1990's to early 2000s period, was at a 'political high' and the National Action Plan website refers to the "the area of salt affected land in Western Australia increasing at a rate of **one football field per hour" and "if salinity is not effectively managed with 20 years, the salt content in Adelaide's drinking water may exceed World Health Organisation (WHO)** standards for desirable drinking water in two out of every five days".[10]

The modeled predictions for dryland salinity, specifically the '17 million hectares at risk', are now considered to be worthy of a review.

Using data sourced from the MDBC own website, graphs show that the Murray River salinity levels since 1982 has steadily fallen and remains well within the WHO standard for raw drinking water of 800 EC.

The CSIRO's Sustainable Yield Report is not specifically commented on at this time due to shortage of the submission closing date. Suffice to say that with any model, an error factor generally exists. Communities concerns in relation to this report exist, but no specific comment can be made at this point.

The Murray Darling Basin Ministerial Council – Sustainable Rivers Audit (SRA) involved the collection of data during a period of extreme drought (2004-2007). This period was part of the more extensive drought (2001-2010). The SRA report was released in 2008.

The reference benchmark for comparison describes the patterns and processes that would be expected to prevail now had there been NO significant human intervention in the landscape. The reports refers to:

> *"It is open to some uncertainty, because it is estimated that than measured'. 'the health of an ecosystem cannot be readily judged by comparison with a database indicating 'normal' ranges for different variables, as ecologists do not have access to the kinds of reference data that a medical practitioner* does'.

The SRA report are schedule at 3 year intervals to the MDB Ministerial Council, this 1st report, which has underpinned the opinions of the MDBA on the health of the Basin Rivers , was only an 'analysis of trends' and was to be the 1st in a series, of 3 reports.

The SRA report, assessed 23 River Valley catchments. Only 1 was considered in good health, 2 in moderate health, 7 in poor health, 13 in very poor health. Assessed on hydrology, macrointertebrates and fish, a river could score well on hydrology, but the presence of alien fish eg carp, together with poor scores on macroinvertebrates, could produce an overall score of poor.

[10] NAP: Salinity and Water quality

On the basis of this and other supporting documents, the MDBA has identified that a minimum of 3000 GL is now required to restore the health of the Basin. Of this approximately 2000 GL is to flow out the Murray Mouth into the Southern Ocean.

The MDBA argue that if this scenario was achieved, it would improve health of the basin and in particular the whole Murray River ecosystem. The MDBA's reliance on increased 'end of system' flows does not acknowledge the range of other influencing factors that have impacted the environmental conditions of the Lower Lakes, Coorong and Murray Mouth.

Historical records show that during major periods of drought, the Murray and Darling Rivers would have dried completely or to a series of pools. Under these scenarios, end of river system flows could be zero or negligible, if assessed as flows from the Murray River itself.

The Murray River originally moved through a series of wetlands and swamps in its lower reaches before entering the estuarine waters of the Lower Lakes.

In high flow or flood events, there would be significantly increased fresh water flows into the Lower Lakes. During periods of droughts or low flows, it was not uncommon for sea water intrusions to occur 250 km upstream in the Murray River.

Salinity readings observed in 1914 show 804 p.p.m at Morgan (1914) and 6,929 p.p.m at Murray Bridge.[14]

During the same historical period, original estimates in 1914, identify that the **tidal prism influencing the Murray Mouth were 16,900 ML**. (Johnston 1917).[11] Historically, flows out the Murray Mouth would be a mix of fresh and marine tidal waters, with the weighting of fresh to sea water, dependent on climatic events.

In 1940, five concrete barrages (7.6km) were constructed across the Lower Lakes in South Australia to convert the Lower Lakes into permanent freshwater lakes. The lake levels were artificially raised in order to enable gravity fed irrigation to occur in the reclaimed swamp land on the Lower Reaches of the Murray River, between Lock 1 and Wellington.

The construction of the barrages removed 90% of the tidal prism and only 11% of the natural estuarine area remains. The current tidal prism has been reduced to a range between 643 and 2,200 ML. [12]

The original tidal prism estimated in 1914 (Johnston 1917) was subsequently revised in 1990 to 20,000 ML. This figure of 20,000 ML is often assumed today, to reflect actual Murray River flows out the Mouth, instead of the original estimate that reflected both marine and fresh water flows.[11]

Changed flow variations have also occurred since 1940, as a result of manipulations of the barrages that release water from the Lakes into the remaining estuary leading out to the Southern Ocean. This is done in order to maintain the Lower Lakes height levels at a static 0.75 AHD (flood height).

11 Bourman, Murray-Wallace, Belperio, Harvey
12 Murray Mouth Advisory Committee

[14] de L'Association Internationale des Sciences

The MDBA identify a range of 'natural' pre development end of system flows. There appears to be differentiation in relevant literature and indeed in the wider public commentary, about what percentage of flows out the Murray Mouth was marine and what was freshwater. In addition flow would change periodically within seasons, months and years. Therefore in determining historic 'mean' or 'median' flows, a range of assumptions may be made.

Despite this, there is a strong reliance by the MDBA that increased end of system flow targets are required to achieve total system health and to ensure a scouring action at the Murray Mouth, to maintain an open channel to the Southern Ocean.

The MDBA in developing the Guide to the Proposed Basin Plan, appears to have endorsed the Federal Department of Environment, Water, Heritage and the Arts (DEWHA) and the South Australian Government's 'Securing the Future – A long-term plan for the Coorong, Lower Lakes and Murray Mouth' (CLLMM). This long term plan of management released in June 2010, was funded by DEWHA as part of a $200 million investment to manage the environmental problems of the Lower Lakes and Coorong.

The South Australian Plan for the CLLMM site states

> "the plan recognized that **large flows down the River Murray will maintain an open mouth** and transport salt and other pollutants to the ocean via natural processes."
>
> "when flows are adequate **to maintain the Lower Lakes at or near optimal operating range, minimal intervention is required** and adaptation actions that aim to build and maintain a resilient ecology at the site are possible".
>
> "the **return of adequate freshwater end-of-system flows (flows through the Murray Mouth)** is essential for any improvement in the health of the site, **as any solution other than freshwater would not preserve the current values** of the site **to the same extent**" [13]

The plan refers to predicted sea level rises under climate change. Based on current projections for the Intergovernmental Panel for Climate Change, there will be a minimum sea level rise of 0.3 metres by 2050 and 1.0 metres by 2100.

The SA Government's long term plan for the site notes that sea level rises may "**lead to a transition of the Lower Lakes to an estuarine environment by the end of the century**".

"Furthermore, 'localised temporary events such as extreme tides (plus surges) as well as storm and wave effects, could raise **water levels locally** and temporarily but nevertheless quite **significantly"**. "**Sea level rises** could also **threaten the barrages** in the medium to long-term, especially during storm events". "Increasingly salty water in Lake Alexandrina could be forced upstream and compromise potable water at South Australian pumping locations in the River Murray below Lock 1". [13]

There are grave concerns about the lack of genuine comprehensive planning for the CLLMM site. This long term plan supported by DEWHA, clearly has a reliance on

[13] Securing the Future CLLMM

increased end-of-system flows - ‘fresh water solution’, achieved via new sustainable diversions limits under the Basin Plan.

This reliance seems even more incredulous climate change predictions for the CLLMM site are included. Under this scenario, the Australian public can rightly assume that the $10 billion dollar taxpayer’s investment to reconfigure the current water dependent economies of the Basin to increase freshwater flows out the Murray Mouth is a complete waste of money.

The ability to maintain the Lower Lakes as a modified freshwater environment and using freshwater flows the Murray Mouth to assist the scouring action, to remove the build up of sand at certain periods, is feasible in higher flow or non drought periods. However changes to operating policies and investments to improve aspects of the barrages, should be a major part of future planning.

What is not feasible, is to maintain current operations and the **expectation that**, even during major drought, the Lower Lakes can be maintain at **historical high levels** and that an objective to **use freshwater**, is the key mechanism to **scour out the Murray Mouth** channel to the Southern Ocean.

This ignores the ecological impact of the barrages, the loss of the historical tidal prism, the continual sand deposits, that occurs with incoming tides and the site’s interaction with natural coastal climatic events, such as storm surges.

The final destination of the Murray River system and its relationship with the Southern Ocean, is not dissimilar to many other Australian tidal delta systems.

However, the Lower Lakes and Murray Mouth estuarine area and tidal delta system, has been substantially modified by river regulation and the construction and operations of the barrages.

A number of reports exist that document and proposed solutions to the environmental impacts of the barrages.

In a report for the Murray Darling Basin Commission (June 2000) – River Murray Barrages Environmental flows – An evaluation of environmental flow needs in the Lower Lakes and Coorong, recommendations included:

- Articulate detailed barrage operating guidelines to meet ecological needs
- Automate barrage gates for more flexible operation and sensitivity to ecological needs
- Modify the Mundoo Barrage to increase flow capacity and operate preferentially to limit sedimentation, at the Murray Mouth
- Evaluate options for relocation and revised management of the barrages to enlarge estuarine area to increase the range of habitats
- Integrate flow management actions with other regional planning and management activities for maximum effectiveness

The continued growth of Bird Island in the Murray Mouth estuary as a result of the location and lack of effective operations of the Mundoo Barrage, remains a risk to future channel capacity in the remaining estuary. This is not addressed by the MDBA. Instead the comprehensive recommendations made in a number of reports on the issue, have been

ignored, in favor of a 'freshwater solution'. This cannot address the stabilization and continued growth of Bird Island.

The Coorong has become an 'icon' in terms of saving the Murray River. As with the issues of the Lower Lakes, there is are broader considerations that the broader public needs to be aware.

The MDBA has received a comprehensive report on the Coorong and Lower Lakes in April 2010 submitted by Southern Riverina Irrigators, but appears to have disregarded it. In addition to this advice, there is a range of literature and detailed information that should have enabled the MDBA to be objective in its deliberations on the Coorong.

Specifically, the MDBA in determining future end-of-system flows have ignored the major cause of environmental decline in the Coorong - the impacts of South Australia's South East and Upper South East, Drainage Schemes. Despite the MDBA verbally acknowledging during consultation, the drainage schemes have redirected flows away from the Coorong, directly out to the Southern Ocean, the Guide continues to reinforce the myth, that environmental problems of the Coorong, are caused by irrigation extractions from the Murray River.

The MDBA Guide to the Proposed Basin Plan and supporting literature, fails to identify what now, is common knowledge.

The claims relating to the Coorong, long held up as the 'icon' issue of environmental decline and a powerful argument to claim more water from the Murray River, can only be described as 'misleading'.

<u>It is essential that the MDBA broaden its views to acknowledge the full range of factors affecting environmental issues of the Murray River, Lower Lakes, Coorong and Murray Mouth.</u>

Key Findings:

- The MDBA have failed to adequately consult with Basin Communities in developing strong foundations for the plan.

- The communities of the Murray Darling Basin question the 'independence' of the MDBA. Specific concerns include:
    a. the strong alignment of the Basin plan with the long term plan for the Coorong, Lower Lakes, Murray Mouth (CLLMM) developed by the South Australian Government and funded by the Department of Environment, Water, Heritage and the Arts.
    b. This CLLMM plan relies on securing increased end-of-system flows, to be the predominant action to keep the Murray Mouth open - the 'freshwater' solution.
    c. the CLLMM plan aims for a 'dynamic estuary' but takes no remedial infrastructure or operating action, to address the ecological issues created by barrages in 1940 which reduced the estuary area to the current 11%, of its pre barrage size
    d. the CLLMM plan identifies that the Southern Ocean will naturally enter the Lower Lakes over the barrages, due to climate change sea level rise predictions (1.0 metre by 2100). Despite this, the MDBA endorses reconfiguring of

e. The MDBA's Guide to the Basin plan appears consistent with the visions, of the Wentworth Group

- The end of system Lower Lakes low water levels, was a reflection of the severity of the broader drought across the Basin, not poor water planning. In Australia's naturally variable climate, this was an extreme but natural event.

- The MDBA plan seeks to reconfigure Australia's food bowl in order to plan for, a one in one hundred year, drought scenario. (eg the scenarios of the Federation Drought 1895- 1903 and the Millennium drought 2001-2010)

- There is insufficient understanding by the MDBA of the experience and complexities in water delivery systems, managed by the States, which prove to be relatively effective in most years.

    1. The Darling River system has experienced low flows similar to previous historic drought events.

    2. The Murray River system under river regulation continued to flow and supply a level of resource to towns, industry and entitlements holders, despite the severity of the drought.

- The MDBA believe that a new Basin Plan can assure flows to the environment and 'increase certainty' of entitlements, even during prolonged periods, of major droughts. (*note: there will be* ***no increased 'certainty' for irrigation entitlements*** *– entitlement volumes will simply transfer from productive use to environmental use)*

- Australia's major dams storages cannot physically store enough water to meet human needs, stock and domestic, irrigation supplies, dilution and losses flows, additional two years guaranteed reserves – plus store enough water to ensure reliable supplies for a ten year 'drought' (of the magnitude of the Federation drought or Millennium).

- The MDBA has failed to factor in existing benefits to the environment, achieved in existing water planning arrangements in the Basin, prior to establishing new rules for more environmental water. This includes comprehensive actions for the environment, achieved under the National Water Initiative, Living Murray and the full range of other environmental water recovery programs – most of which have not been monitored or assessed, due to the prolonged drought event.

- There are significant concerns regarding the foundation science used by the MDBA in developing the Basin Plan. The MDBA has relied on existing data which may/may not be adequate for the purposes of the Basin plan

- The MDBA uses hydrology and a set of 'indicator sites' as a measure of Basin Health. This is contrary to all previous Government and community investment and planning for Total Catchment management. There is a presumption that 'flow volumes = river health'

- The MDBA in the Guide to the Proposed Basin Plan, has failed to developed a comprehensive plan, for the delivery of proposed environmental flows to the

1. Flood risk are not specific just to the volume of the environmental water to be released, but its relationship to other factors such as the timing of releases, seasonal rainfall, dam capacity and water levels of creeks, rivers and billabongs.

2. Natural capacity constraints of Murray River (eg Barmah choke) limit the flow volumes required to meet all demands. The MDBA have stated that there will be an impact on the 'reliability' of entitlements, but given the lack of information how environmental volumes will be managed, it is difficult to determine the full impacts for existing water license holders and their future ability to access their entitlements in peak periods.

- Social and economic studies have been minimal at best, totally inadequate at worst with the impacts assessments being confined to entitlement loss. This does not reflect the full range of issues. The MDBA in determining the Sustainable Diversion Limits (SDLs), has acknowledge that they wish to limit impacts below 40%. Without the full range of factors being included in the basin plan, it is impossible for the MDBA to draw any conclusions about impact.

    1. There has been no socio economic impact assessment on the consequences to changes to the 'reliability factor' of entitlements, particularly when the full Basin Plan's implementation is delivered through new State Water Sharing Plans post 2014. (or 2019 Vic)

    2. There has been no socio economic on risks of the delivery of environmental flows. In particular, third party flood risks to either individuals or relevant Shire Council Assets including road or asset management programs. It is not clear who or how compensation will be paid for 3rd party flood damage. This is despite a confidential note reflecting the MDBA is aware of potential flood risks, obtained under the Freedom of Information laws

    3. It is widely acknowledged that the MDBA stated '800 job losses' reflects a very poor analysis of impacts, that is beyond the standards expected of a Government appointed authority

- The MDBA has not provided or encourage the use of engineering solutions, as a key mechanism, to restate mid level floods to water specific wetlands that cannot be watered without achieving over bank flows. This is critical to prevent third party flood risks. Although engineering solutions are considered, they are not the preferred option by the MDBA, as identified during rounds of public consultation. The MDBA has publicly stated in consultation on the release of the Guide, that they would not recommend or include 'modifications' to the Lower Lakes in South Australia.

- River regulation has modified the natural flows and impacted on the natural flood regimes of the Murray and Darling River system. Strong differences prevail between the Northern Darling System and the more regulated and highly populated areas of the Southern regulated system of Murray and Murrumbidgee. In order to re-state small to moderate flood events to water ecological assets outside the main stem of the Murray

- The MDBA appears to have endorsed a pre-determined position to use 'end of system flow' volumes, to address the ecological problems of the Lower Lakes, Coorong and Murray Mouth, that should be attributed to a range of factors, not primarily related to river flows

- The plan fails to identify the range of factors affecting the Murray Mouth, indeed the plan helps cement widespread misunderstanding of the reason for Mouth Closure in 1981. There has been no attempt to provide more comprehensive information, in particular;
  1. the increased sedimentation or 'shoaling' that has occurred since the construction of the initial barrage (1917) and subsequent (1940) barrage over the Mundoo channel.
  2. The unusually calm seas that prevailed at the time (autumn 1981) and how the current five barrages operations and locations, have significantly increased sedimentation in the tidal delta of the Murray Mouth Zone.
  3. The growth of Bird Island has resulted from the construction and operations of the barrages (Mundoo) and the impact of increased sedimentation, cannot be addressed by increases to 'end of system' flows.

- The MDBA have failed to adequately explain the relationship (if any), for increasing volumes to the Lower Lakes and the benefits derived to the continued expansion of housing development and associated waterfront canal system at Hindmarsh Island. There is no 'interception' information by the MDBA in relation, to this development.

- The MDBA support for increased 'end of system flows' and a 'fresh water solution' for the CLLMM site, fails to factor in:
  1. reduced inflows resulting from significant Wildfire events in the Snowy Mountains and the headwaters of the Murray River
  2. future inflow risks resulting from carbon forest plantings on local and headwater catchments

- The MDBA note that the SDLs will be determined after factoring in Plantation Forestry and other interceptions actions eg farm dams. This implies that there is an allowance of 'growth' for forestry and that large scale forestry interceptions will be subsidized by reductions to existing water entitlements holders assets, when setting the SDLs.

- The MDBA has prided itself on 'community consultation'. Despite limited consultation, there is no evidence in the Guide that responses from the community have been built into the plans. Statements or information made during consultation or through submissions, letters to the Board or other literature, appear to have been ignored. When issues have been identified, there appears to be a reluctance to 'change'.

Executive summary conclusion:

The MDBA should be congratulated for releasing the Guide to the Proposed Basin Plan, giving the opportunity for all Australians to understand the ramifications of the Basin plan, prior to the development of the formal Draft and its sixteen week consultation period.

Key concerns have been identified through the release of the Guide, including the independence of the authority and the science that has underpinned the decisions of the MDBA.

It is acknowledged that the Water Act 2007 is fundamentally flawed and in its current form, cannot address the balance of social, economic and environmental factors required. The MDBA is bound to meet the Act and this is understood by the community.

During consultations, it was repeatedly requested that the MDBA report to the Federal Government about the deficiencies of the Water Act 2007. It is disappointing that the MDBA, could not make a public statements to this effect.

There is also significant risk that a lack of understanding about environmental sites listed under International Environmental Agreements, will result in poor decisions making in the basin plan. International agreements have been prioritised as a result of the design of the Water Act 2007 and this will takes environmental water planning to a new level.

It is important to acknowledge, that the determination of site management and ecological thresholds are not cemented under International Law and Australia's plans of management and ecological character descriptions, have continued to evolved over time.

As such, Australia retains control over the management and environmental character descriptions in relation to Australian Ramsar sites.

Australia is to invest a further $10 billion dollars in enhancing the environment of the Murray Darling Basin.

The scale of this investment should ensure a more rigorous basin plan, that is supported by strong scientific principles and actions, that can protect the environment and the economic worth of the basin, in our unique Australian environment.

It is vital that the robust decisions for the efficient use of environmental water are in place to minimise the impacts on the taxpayer and to balance the requirements of Australia's future food production. This has not been done, nor appears supported by the MDBA.

To avoid permanently damaging Australia's food bowl, it is essential that the process of major investments in the environment, are built on strong foundations.

Australians have been educated to believe that the 'mighty Murray' is significantly 'unhealthy' and that major public investments are required to restore its ecosystem function. This is despite the fact, that significant benefits have been derived from the regulated water supplies of the Murray and it continued to flow during one of the worst droughts in history.

The Murray River is still classed as well within, World Health Organisation's raw drinking water standards of 800 EC and under a regulated system since 1940, it has continued to provide benefits to the environment, social and economic well being of this nation.

The extent and severity of the drought (2001- 2010) across the Basin has caused significant environmental, social and economic stress. However, this drought was beyond the capacity

or ability of the Basin planners to prevent and should be considered in the historical context of the Federation Drought (1895-1903).

The Guide to the Proposed Basin Plan and the associated public investments, require a more comprehensive approach, to addressing the more complex issues of the Murray Darling Basin. Prior Government and community investments in water planning, should have time to be fully implemented and monitored in 'non drought' periods, prior to the 'Goal Posts' for the environment being re-set again.
It is time for all Australians to analyse whether new claims for the environment are justified and will deliver the benefits claimed. At stake, is the heartland of Australia's food production.

The Social and Economic consideration of this are not confined to those holding license entitlements to water, nor to the dependent communities. This is an issue for all Australians.

It is not just the $10 billion investment under the Water for Futures Program which includes delivering the objectives identified under the MDBA Plan. It is the continued public expenditure on previous and current politicized issues relating to the Murray Darling Basin, where sound science can be overlooked, in favor of environmental advocacy.

This document provides an over view of the Murray Darling Basin planning process for managing water extractions and the environment. This interim report does not attempt to address the entire Basin Plan. It does provide an overview of reform, but specifically focuses on water planning for the environment, in the Murray River southern connected systems.

In developing the Basin Plan, it is important to acknowledge the limitations of Australia's key water storages on the Murray Southern connected River system.

SECTION 1

AUSTRALIA – A DRY CONTINENT

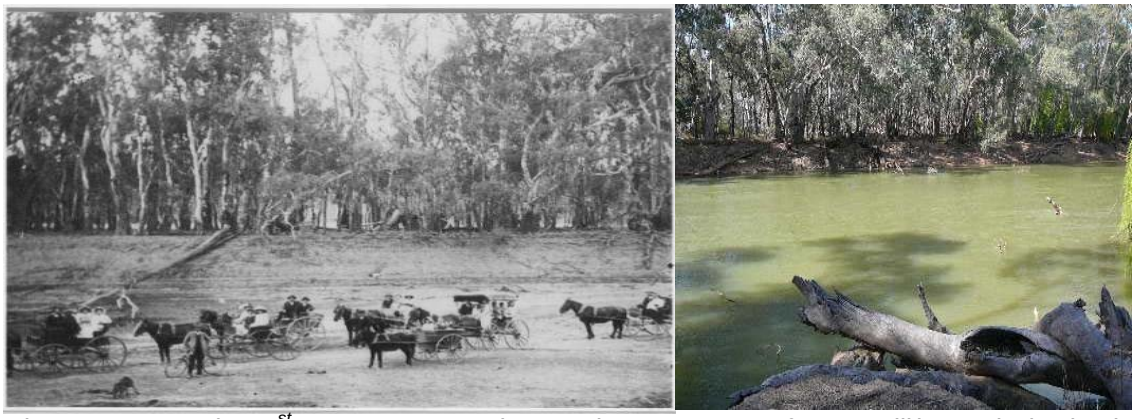


Photo1: Murray River 1st January 1914 –photo, 50kms upstream of Swan Hill(natural River) Photo 2: Murray River 2002 – the 'Millennium' drought (regulated river)

Extract from the Murray Darling Basin Commission website:

"In its natural state the River Murray was quite different from the regulated river we have today. During severe droughts it was sometimes reduced to a chain of saline waterholes. In South Australia, sea water infiltrated upstream for a considerable distance from the mouth.

In most years, Adelaide draws more than 40% of its water from the Murray. During droughts such as that experienced in recent years, this dependence increases to more than 90%. Without our present system of river regulation, the population of Adelaide and many other cities and towns in the Murray Valley would be considerably smaller than they are today.

Since the completion of Hume Dam in 1936, a continuous flow has been maintained throughout the length of the Murray. Without storages and regulation, the Murray would almost certainly have ceased to run during the droughts of 1938-39, 1944-45, 1967-68, 1982-83 and 1997-98. The drought conditions experienced in the last few years have shown that even with storages and regulation, extended dry climatic conditions could stop the Murray from flowing" [15]

Australia's climate, compounded by the variability of its rainfall, mean that virtually all of Australia's river systems are subject to considerable variability of flows from one year to another. Australia experiences (together with South Africa) experiences higher runoff variability than any other continental area. The Muray Darling Basin is no exception to this, in spite of the fact that much of the river system is highly regulated…"

[15] MDBC

“The upper Murray, Murrumbidgee and Goulburn river catchments account for 45.5 % of the Basin’s total runoff from 11% of its area. The upper Murray catchment alone, accounts for 17.3%. “The Darling River system, contribute 31.7% of the Basin’s mean annual runoff from 60.4% of its area”.

“86% of the Basin contributes virtually no runoff to the river systems, except during floods”. [15]

“In times of drought, the storages, provided they contain water, add to river flows, as illustrated by the contributions of the Snowy Mountains reservoirs to flows in the Murray during periods of drought”. “For the Murray and Murrumbidgee, the high and relatively reliable precipitation in their source areas, mean that stream flows are much more reliable than in other parts of the basin.”

“The Darling River and its tributaries have much less reliable flows as the ‘rivers not experiencing massive floods…. can cease flowing for extended periods. The Darling… at Menindee between 1885 and 1960, ceased to flow on 48 occasions. The longest period of no-flow was 364 days in 1902-1903”. [15]

Photo 1: Darling River, Bourke 1941 – Bourke Shire Library,
Photo2: Murrumbidgee River- Balranald Power & pump station 1938 (R Bodinnar collection)

Visionary water planning by previous generations of Australians together with Federal and State Governments, have enabled current generations of Australians to enjoy and prosper from the regulated water supplies, of the Murray Darling Basin.

The construction of the Hume Dam (16km east of Albury) commenced in 1919 and the original capacity of the dam was enlarged in 1961 as part of increased flows derived from the Snowy Mountains Scheme. Storage capacity of the Hume is 3038 GL with a catchment capacity of 15,300km2. In 1957, a 50 megawatt hydro-electric station was incorporated into the Hume Dam to generate power as water is released.

15

The construction of the Hume Dam was for secure water supplies, irrigation, flood mitigation and drought control. In its earliest planning stages (ie 1919), navigation was also a consideration. [3]

> "The principle purpose of Hume Dam is to conserve water in periods of high flow for later release during periods of low flow. The principle use of the water is for irrigation, but significant quantities of water are diverted from the River Murray for domestic use, industrial uses and to help supply entitlement flows to South Australia' [3]

Dartmouth Dam has a capacity of 3906 GL and was constructed by the Victorian Rural Water Commission for the River Murray Commission (MDBC now MDBA). The Dam construction was finished in 1979 and is located near the Mitta Mitta and Dart rivers. [3]

The Hume Dam is the Murray Darling Basin Commission (now MDBA) 'primary regulating storage. [3] Inflows from the Hume catchment, excluding Dartmouth and the Snowy Mountain Scheme, are variable, but equal, on average, to the storage capacity. Inflows in a drought year are only about 10% of those in a flood year. Releases from Dartmouth Reservoir are controlled by the Murray Darling Basin Commission [16]

Hume and Dartmouth are operated so that releases can ensure the available 'airspace' with the two storages. Such planning enables appropriate flood mitigation strategies to be in place to minimize flood risks between the two storages.

In the peak water supply periods, South Australia and the Murray River irrigation areas requirements can exceed 30,000 ML/d.[3] The Murray River channel capacity cannot physically deliver this water without causing flooding. The use of mid river storages such as Lake Victoria can assist with storing water to enable the effective delivery of entitlements in most peak demand periods.

The Murray River between Hume and Yarrawonga can only physically pass 25,000 ML/d before causing flood events. Further downstream, a natural physical constriction of the Barmah Choke, limits flows to 8,600 ML/d. In order to overcome these restrictions, the Mulwala Canal and the Edward River are used to pass up to 2000ML/d, thus bypassing to some extent the natural limitations of the river's water delivery capacity. As it takes up to a month for water flows to reach the South Australian border, releases "must be made up to a month in advance" [3]

It is important for the MDBA to factor in the natural or operational constraints of the major storage dams and Murray River channel capacities when determining the scale of water to be recovered for the environment.

The MDBA has not developed an 'environmental water delivery plan' and given the natural constraints of the river system, it is unclear how the scale of water recovered for the environment will be delivered.

The social and economic analysis commissioned by the MDBA has focused on the economic and job impact on entitlements resulting from the proposed Murray Darling Basin Plan Sustainable Diversion Limits (SDLs). There has been no analysis of risk in

[3] MDBC
[16] MDBA

terms of ability to access entitlements, (thus reliability impacts) or potential adverse flood risks to individuals, the State of NSW or individual Shire Councils in the delivery of environmental flows.

The Snowy Mountains Scheme was the world largest hydro-electric scheme situated in the Southern Alps of Australia. The water catchment is approximately 5124 km2 with a large proportion of this area in the Kosciuszko National Park. The scheme was built over 25 years and completed in 1961. The scheme had a workforce of over 100,000 people whose origins included many countries of the world. There are approximately 145km of tunnels and 80km of aqueducts, that collect and move water within the scheme.[17]

The scheme's design was to provide hydro electric power and to provide irrigation water to the Murray and Murrumbidgee Rivers. The Scheme in total has the storage capacity of 7000 GL and of this approximately 5300 GL could be used for electricity generation and then diverted into the Murray and Murrumbidgee Rivers [17]

Of the 16 major dams, Lake Eucumbene, has the largest storage capacity of 4798 GL. Water entitlements are shared between Victoria (24%) and NSW (75%) [17]

Under the Snowy Mountains Hydro-electric Power Act, as the water passes beyond the Snowy Hydro system, control of water is then passed to Murray Darling Basin Authority (previously MDBC) and in the case of the Murrumbidgee River system – to the NSW Office of Water.

The Snowy- Murray System delivers annually 1062 GL to the Murray River and 1062 to the Murrumbidgee as part of its license. On average 1210 GL are released into the Murray system.[18]

According to the MDBA, the long term average surface water inflows for the basin are approximately 32,800 GL. Of this approximately 19,100 remains with the environment including losses such as evaporation with about 13,700 GL (42%) extracted for consumption (irrigation, urban water supplies, industry)[16]

In the Murray Darling Basin Guide to the Proposed basin plan, the guide identifies that **58% of current inflows remain in the environment** [16]

Over the period 1894-1993, the annual discharge at the mouth of the Murray-Darling system has ranged from **1626 GL to 54,168 GL,** with a mean of 10,090 GL and a median of 8,489 GL (maheshwari et.al.1995).[3] Even with this particular assessment, it is worth noting that flows would have varied in particular seasons of the year and as the mean and median terminology influence the high flows and low flow periods, it is clear that significant flow variation have occurred.

Creation of the Murray River

Australian Geographic, 'the Murray River' states:

> "the key to the Murray's existence lies in the formation of the Murray Darling Basin. This had its beginnings in a large shallow rock depression dating from 350

[17] NSW Government; Dept of Education website
[18] NSW Department of Natural Resources 2006
[16] MDBA

million years. About 100 million years ago (mya), as the mountains of the Great Dividing Range began rising through the Earth's surface, a large depression west of the divide began to subside and deepen".[22]

"for most of the past 65 million years, the western portion of the Murray Darling Basin was almost continuously covered by warm, shallow seas and marine lakes intruding from the Southern Ocean. These contributed sediments to the basin's floor, including limestone deposits that survive today as crumbling cliffs along the river in South Australia.[22]

"After Australia finally separated from the supercontinent Gondwana 50-45 mya, sea levels around the world rose. A finger of salt water, name the Murravian Gulf, extended from the Southern Ocean into the Western half of the Murray Basin about 32 mya. At its peak, about 20 mya, it stretched beyond the site of present-day Swan Hill, before retreating about 12 mya." [22]

"Vast climate change characterized the next chapter in the basin's history, with the sea repeatedly encroaching and retiring." "From 6-4 mya, the westward flowing rivers chased the retreating sea deep into South Australia and started forging routes to the Southern Ocean. But just over 3.5 mya their paths were obstructed south of present-day Swan Reach, when a massive earth uplift called the Padthaway Block, dammed the rivers and created the giant freshwater Lake Bungunnia. Filling over several thousand years, the lake eventually covered some 33,000 sq. km and extended north almost to today's Menindee Lakes. It survived until about 700,000 years ago, when it breached the "dam" and drained."[22]

"As Lake Bungunnia emptied, a dominant river – the Murray – began cutting a new channel across the old lake bed, incising deeply into the accumulated limestone deposits."[22]

"For the past 500,000 years, the Murray Basin's climate has remained mostly dry. Lower temperatures reduced evaporation from soil and water and transpiration of moisture from plants. With more moisture being retained in the soil, water tables rose, wetlands formed and rivers swelled"[22]

The soils and geological characteristics, are a reflection of the Murray Darling Basin's origins, with salts being a natural part of its marine history.

In its birthplace in the Great Dividing range, the Murray River today commences its journey as a relatively small stream, building momentum on its journey to the Southern Ocean in South Australia.

While small in its upper reaches the Murray River, expands in size as it moves to a more identifiable river form in the region now covered by the Hume Dam. From there, the Murray travels within higher bank formations, to a region of natural physical constraint, known as the Barmah Choke. Here the Murray River is reduced to a mere 27-30 metres wide.

At this point, historical seismic events in last 60,000 to 100,000 years caused the Murray basin floor to rise up and the Cadell Tilt blocked the westerly flows of the Murray and

[22] Australian Geographic

Goulburn Rivers. The old bed of the Murray River is still evident in an area referred to as Green Gully.[23]

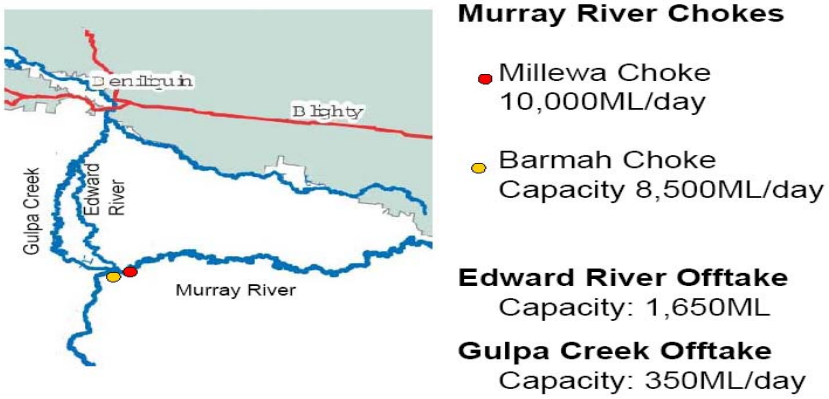
The Murray River began to flow in a northerly direction on a river bed now referred to as the Edward River. Lake Kanyapella formed extending over an area from south of Moira to beyond Echuca. The Goulburn flowed South of Cadell Fault near what is now know as the town of Echuca. At this time, the river area was open woodlands and grassy plains. Pollen from soil tests identify that red gums only colonized the area about 6000 years ago.[23]

In relatively recent times, possibly either just before or after the arrival of aboriginal people, the Murray setting a new course south where its water merged with the Goulburn. By then Lake Kanyapella had dried up although part of the depression today still fills in large flood events.[23]

According to the Mathoura historical information sheets, "scientific testing by Dr Tim Stone of the section of river bank between Picnic Point near Mathoura and the Victorian town of Barmah (known as the narrows or the Barmah choke) have shown that the channel is only about 550 years old. The river here has straight-side banks whereas older sections of the river show the normal sloping sides of a mature stream" [23]

Murray River (photo L Burge -Barmah choke 2008) (water flow capacity – 8500 ML/D: width 27-30m)

Barmah Choke 'the narrows' (photo T Goodwin 2010) (water flow capacity – 8,500 ML/d: any additional flow over top the river bank causes unseasonal flooding)



(figure: Murray Irrigation Limited)

As the Murray River, moves beyond its headwaters and the natural narrowing of the Barmah choke, the river formation broadens as it joins the waters of the Darling River system at Wentworth. In its final journey in South Australia, the Murray River became a

[23] Mathoura Historical information sheet

wide river expanse before emptying its waters in the historical estuarine system of the lower wetlands and lakes system adjacent to the Southern Ocean.

The natural physical capacity of the main stem of the Murray River, (Millewa choke) and the Barmah (choke) has significant ramifications for the Federal and State Governments in relation to the delivery of large scales of environmental water proposed by the Murray Darling Basin Plan.

HISTORY OF WATER PLANNING (summary)

Australian river systems of the Murray Darling Basin are historically variable depending on the climatic conditions in the Southern Hemisphere.

The fluctuating nature of Australia's inland river and creeks is acknowledged by many, however there is a need to pause and reflect on how past investments and water planning have enabled a more secure and stable water supply for the nation.

The Cooperative Research Centre for Catchment Hydrology states:

> "in concert with a high degree of spatial variation, Australian rainfall is highly episodic and stochastic when compared to other continents from the same latitude or with similar climatic zones (McMahon et al. 1992). Australia is characterized by high seasonal variability across the continent and a high frequency of drought/flood oscillations (SOEAC 1996).[24]

Early Australian explorer journals refer to the river and creek conditions varying from dry ephemeral streams, through to raging rivers and floodplains, that were difficult to navigate.

Fluctuations in river heights, are evident from the characteristics of the river banks, which could indicate flow patterns over many centuries.

European settlement in 1750 precipitated the start of a journey for a number of Australian rivers, where natural variations were modified to meet the needs of future generations.

Early settlers took the opportunity to create small scale water storage systems in creek formations to capture water. These small stream interceptions perhaps were the forerunner to large planning works that would service Australia's growing population.

The advent of Government planning and investments in water, saw a shift in attitude where the potential of secure and stable river heights opened opportunities for navigation, irrigation and secure urban water supplies.

Such plans for water included the Water and Conservation Act of 1880, the Victorian Irrigation Act 1886 and the River Murray Waters Agreement in 1915, ratified by the Commonwealth in 1917.

[24] Cooperative Research Centre for Catchment Hydrology

Despite planning for water security, Australia's climatic events would continue to dominate water availability.

Notable droughts include the periods of 1864-66, 1880-86, 1895-1903 (Federation drought), 1911-16, 1918-20, a dry period extending from1933- 1945 - with severe drought within this period from 1939-45, 1958-68, 2001-10.[25]

The sustained Federation drought of 1895-1903 and critical year of 1902, led to large scale planning and investment in securing water supplies for Australia's future.

Following the Federation drought, an agreement was reached between four State Governments to secure reliable water supplies and expand irrigation.

The River Murray Waters Agreement was agreed by the States in 1915 and ratified by the Commonwealth Government in 1917. The Agreement was overseen by the River Murray Commission. This Agreement was amended in 1987 with a new Murray Darling Basin Agreement being signed in 1992.

The Basic principles of the original and subsequent amendments, remain in place today.

The River Murray Waters Agreement also provided:

1. Flow at Albury is shared equally between New South Wales and Victoria
2. Victoria and New South Wales retain control of their tributaries below Albury
3. Victoria and New South Wales supply South Australia with a guaranteed minimum quantity of water or 'entitlement'

The River Murray Waters Agreement also provided:

1. A storage on the upper Murray (Hume Dam)
2. A storage on Lake Victoria
3. 26 locks and weirs extended up to Echuca (14 were constructed)
4. 9 locks and weirs on either the Murrumbidgee or Darling River (Murrumbidgee resulted)

Original State sharing arrangements were further amended with the completion of the Dartmouth Dam in 1979, when during negotiations, South Australia's entitlement was raised from 1500 GL to 1850 GL as a condition for the abandonment of the proposed Chowilla Storage dam due to salinity issues at the proposed site. Prior to these negotiations, South Australia had approximately 3/13th share of the Basin resources, with New South Wales and Victoria sharing 5/13th each. Despite South Australia being only 6.7% of the Basin, modifications to State sharing agreements, gave South Australia a new equal entitlement share of the Basin water resources, with a higher degree of reliability than other States.

The River Murray Commission was superseded by the Murray Darling Basin Commission in the 1980's and integrated catchment management began to dominate natural resource planning in the Basin.

The Murray-Darling Basin Cap (CAP ON DIVERSIONS)

The Murray Darling Basin Ministerial Council

[25] Australian Newspaper

> ‘amid growing concerns about the changes to the flow regimes in rivers within the Basin and their consequences, the Ministerial Council (Murray Darling Basin Commission) in June 1993 initiated an audit of water use in the Murray-Darling Basin. The Audit, which was completed in 1995, showed that if volumes of water diversions continued to increase, this would exacerbate river health problems, reduce the security of water supply for existing irrigators in the Basin, and reduce the reliability of water supply during long droughts.’[3]
>
> “In response to the findings of the Audit, a limit was imposed on the volume of water which could be diverted from the rivers for consumptive uses. This limit is called the Cap. An interim Cap was imposed in June 1995. Following an independent review of equity issues, a permanent Cap for New South Wales (NSW), Victoria and South Australia was implemented from 1st July 1997.3

For NSW and Victoria, the Cap is defined as “*the volume of water that would have been diverted under 1993/94 levels of development*”. For Queensland (a moratorium on further development in place since September 2000) and the Australian Capital Territory which together divert less than 7% of total water being diverted in the Basin, the Cap arrangements are still being worked out.”3

The Murray Darling Ministerial Council meeting 29, 25th August 2000, included Schedule F to the Murray Darling Basin Agreement to further defined the Cap in terms of operation, monitoring and reporting. This schedule defined:

- Long term diversion Cap for each state
- Power of Ministerial council to alter long-term diversion caps
- Develop analytical models
- Calculation of annual diversion targets
- Monitoring and reporting
- Appointment of an Independent Audit Group
- Annual audit by the Independent Audit Group
- Power to require a special audit of a designated valley
- Special audit by Independent Audit Group
- Declaration that diversion cap has been exceeded
- Advice to Ministerial Council on remedial actions 3

National Water Initiative

Australia water reform process was further developed on February 25, 1994, when the Council of Australian Governments (COAG) agreed to the establishment of the Water Reform Framework

The Intergovernmental Agreement on a National Water Initiative (NWI) was signed at the 25 June 1994 at the COAG meeting. The Tasmanian Government joined the Agreement in June 2005 and the West Australian Government joined in April 2006. The oversight body to the NWI was the National Water Commission [26].

The NWI represents a shared commitment by governments to increase the efficiency of Australia’s water use, lead to greater certainty for investment and productivity for rural and

[3] MDBC
[26] National Water Commission

urban communities, and for the environment. A founding principle of the NWI was a balance between social, economic and environmental considerations.

Under the NWI, governments have made commitments to:

- prepare water plans with provision for the environment
- deal with over-allocated or stressed water systems
- introduce registers of water rights and standards for water accounting
- expand the trade in water
- improve pricing for water storage and delivery
- meet and manage urban water demands

The Murray Darling Basin over the period of 2001-2010 has experienced severe drought. The continued extent and severity of the drought has meant that many of environmental benefits achieved through these Water Resource Plans have not had the opportunity to be tested, as to the effectiveness of planning to meet ecological objectives.

Water Act 2007

Specific aspects of the reforms principles of the NWI agreed to in 2004, were to be implemented across all Basin States and implemented under a new Federal Water Act.

The Federal Coalition Government sought Commonwealth powers on water by introducing the Water Act 2007. However, Federal powers on water were limited as determined by the Australian constitution. During this period, significant political differences occurred between the Federal and State Governments. In the broader public sense, water issues had also, become highly political.

The drafting of the Water Act 2007 was subject to considerable variations but 'without the political will of the States, the Act's very constitutional validity was in question. [27]

The Australian constitution (section 51) identifies the legislative powers of the Commonwealth. Under the arrangements of the Australian Federation, 'power is reserved to the States except that which are specifically provided to the Commonwealth at Federation [27]

The Water Act 2007 enabled the Commonwealth Government to over ride water powers, held by the States of Australia, through the provision of 'external affairs' powers under the Australian constitution (section 51). The Water Act 2007 refers to this in Section 9 (NSWIC). To trigger the use of such powers, the Federal Coalition Government used international environmental agreements and conventions. (eg Ramsar)

The final wording of the Water Act 2007, designed by Commonwealth as a mechanism to obtain a level of power of water over the States, places the environment as the key priority over all other considerations.

The Water Act 2007 therefore, is inconsistent with all principles of ecological sustainable development (social, economic, environment); is against the agreed principles of the National Water Initiative; and is against the agreed Australia's own National Standard for Ecological Sustainable Development (1992).

[27] NSW Irrigators Council

In 2007 the Federal Parliament passed The Water Act 2007. The Act was amended in 2008. This included an amendment provision to protect the interests of human supplies of water that were critical for towns and cities.

This Act:

- **Establishes the Murray-Darling Basin Authority** (MDBA)
- The Act requires the MDBA to prepare the **Basin Plan**
- Establishes a **Commonwealth Environmental Water Holder**
- Australian Competition and Consumer Commission **(ACCC)** - key role in developing and enforcing **water charge and water market rules** (in line with NWI principles)
- Gives the Bureau of Meteorology **water information** functions that are in addition to its existing functions under the *Meteorology Act 1955*.

Key elements of the Basin Plan include:

Sustainable Diversion Limits (SDLs)
The MDBA will set Sustainable Diversion Limits (SDLs) as part of the new Basin Plan. The State Governments will establish new water sharing plans (WSPs) to meet the new extraction limits – SDLs. This will occur from 2012, (NSW 2014) (Victoria 2019)

The SDLs, will "take into account the best available science, and the 'precautionary principle'. According to this principle, if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation"

Water Trade Rules
The Basin Plan will include water trade rules to enable a Basin wide approach under the new Plan. The development of Water Trade Rules are being managed by the ACCC

- The removal of barriers to trading water rights
- The terms and process for trading water rights
- The manner in which trades of water are conducted
- The provision of information to enable trading to take place

Social and economic analysis and implications
The Basin Plan is required to describe the social and economic circumstances of the Basin communities that depend on Basin water resources. The MDBA will assess the socio economic implications of any reductions in the long term average SDLs. Governments will use this information to consider appropriate responses to social and economic impacts of the Basin Plan.

The Basin Plan will also include:
Environmental Water Plans
Water quality and salinity management Plans
Monitoring and evaluation
Audit of the Basin Plan's implementation

INTERNATIONAL ENVIRONMENT AGREEMENTS

Australia's water resources are also subject to a range of voluntary international agreements on the environment.

International agreements affecting Australia's water resources include "the Convention on Biological Diversity, the Convention on Wetlands (RAMSAR, Iran 1971), the Japan/Australia and China/Australia migratory bird agreements (JAMBA and CAMBA), the Convention on Migratory Species, the Convention to Combat Desertification, the Commission for Sustainable Development and the United Nations Environment Program.

South East Asian Migratory Bird Flyway zone – Ricegrowing region of the Southern Riverina

(photo L Burge, Deniliquin)

Australia also participates in non treaty bodies such as the Valdivia group of Southern Hemisphere countries".[28]

The International Union of Conservation of Nature 'World Conservation Strategy' is identified by the Cooperative Research Centre for Catchment Hydrology as the 'first global statement on sustainable development, although it is less well recognised than the World Commission of Environment and Development meeting of 1987" [24]

In 1987 the World Commission of Environment and Development (WCED 1987) released the Brundtland Report which argues for 'mutual reinforcement of economic and environmental policy.[24]

Australia's participation in the 1992 United Nations Conference on the Environment and Development in Rio de Janeiro established policies for the Environment, Climate Change, Forests and Biodiversity.

Australia's National Strategy for Ecological Sustainable Development (Dec 1992) endorsed by the Council of Australian Governments (COAG), accepts there is no universally accepted definition of ESD, but is largely based on internationally recognised principles of ecological sustainable development that seek to achieve a balance of environmental, social and economic needs.

Australia was one of the first countries to sign up to RAMSAR in 1974. This inter-governmental treaty establishes a national approach and international cooperation for the conservation and sustainable use of wetlands.

Australia, has a range of sites nominated for listing and incorporates both public and private lands. The Ramsar Convention is a global treaty and the principle for management of sites

[28] Australian Government, Dept Sustainability, Environment, Water, Population & Communities (web)
[24] Cooperative Research Centre for Catchment Hydrology

is "the Wise Use Concept" – "the conservation and sustainable use of wetlands and their resources, for the benefit of humankind." [29]

Once a site has been listed under Ramsar, a plan of management is developed by the nominating country. As part of, or at a subsequent date, the site's ecological character descriptions are developed to assess future monitoring.

Importantly, countries such as Australia signing up to international treaties or agreements on the environment, do so in a voluntary capacity. Non adherence to the agreed principles for signatory countries, are generally addressed through negotiations, or a range of other non legal avenues.

The nominating country (eg Australia) designs the management plan for a Ramsar listed site and the method of management to retain the site's identified characteristics. As part of agreed principles, the nominating country would provide reports to the Ramsar secretariat, on progress of management and any significant changes, natural or otherwise.

In Australia, if a site is listed under Ramsar, objectives of management aim to preserve the ecological character that was evident at the time of listing. This raises potential concerns about human decision making about desired objectives for the site which can be influenced by the date of listing, what type of environmental conditions prevailed at the time and what environmental characteristics would have historically.

The Coorong Lower Lakes and Murray Mouth site was included under Ramsar in 1985. The actual plan of management was not developed until 2000. The detailed 'ecological character descriptions' were not completed until 2005.

Hypersaline conditions of the Coorong were included in 1985 as part of the broader ecological character description of the site. This identifies that significantly modified sites can still attract Ramsar listing in line with the Ramsar principle of 'wise use'.

Further this particular site was noted in a letter to Ramsar in 2006, to have undergone significant changes as far back as 20 – 30 years prior to the time of listing in 1985 (approx 1955).

The **Millewa Forest of NSW** was officially recognised as a **Ramsar wetland site in 2002** when proposed by the NSW State Forests. A Forest Management Plan was developed by NSW State Forests which included an ecological character description on which to assess future management. The ecological character description now appears to be under review given the change of tenure to National Park 1st July 2010.

The detailed ecological character descriptions have not been released, indicating perhaps new policy changes aligned with the change of management tenure from NSW State Forest control, to NSW National Parks. **The MDBA has utilised the Barmah Forest** (Victoria) **ecological character description** which was listed in 1982.

As the timeframes between listing a site, determining a plan of management and identifying its ecological characters may evolve over decades, it is clear that the nominating country retains control over the site and may amend aspects of the site as required/desired.

[29] Australian Government, website – Ramsar Convention

In terms of water planning in the Murray Darling Basin, international agreements have now reached a new level of prominence due to the construction of the Water Act 2007.

Australians should acknowledge specific conditions and continued management rights for sites listed under the Ramsar agreement.

It is important to recognise the parameters in relation to listing of individual sites under an international treaty or agreement (eg Ramsar), the timelines of the listing, plans of management and determination of ecological characteristics.

These decision points, may be relevant for how the Australian Government determines the future management of waters and economic basis of Australia's food production, in the Murray Darling Basin.

WATER PLANNING AND THE ENVIRONMENT

NEW SOUTH WALES

This interim report provides an over view of NSW actions on water reform. The report specifically focuses on the Southern connected systems, primarily - the Murray River region.

Overview: Darling River system (Northern NSW)

The Northern Floodplain and Darling River system operates on a different water management regime to the Southern Murray connected systems in NSW.

The Darling River system irrigation systems and water sharing arrangements operate on the basis of floodplain extractions and releases from smaller storage systems than in the Southern Murray connected systems.

The Darling system water sharing plans, in general operate on flow based rules for extractions on the floodplains. Water sharing arrangements between the environment, community and agricultural systems reliant on irrigation, has been developed around a highly variable floodplain. (SRI)

Water entitlements are generally managed on 'flow rules'. Water Sharing Plans will determine when entitlement water can be accessed. The rules and issues of floodplain management and water access operate in vastly different spheres than those of the regulated system in the South. (eg Murrumbidgee, Murray)

Overview: Southern connected systems (Southern NSW)

In the Riverina region of NSW, population densities are more developed and water management is largely controlled by major dam storages. The rules around water entitlements for irrigation, are based on the system of seasonal annual 'announced allocations'.

In political and media terms, the perception of 'over allocated' is incorrect. The Southern connected systems have licensed entitlements and at the start of each, water planning year, announced allocations to those entitlements occur. The announcements in general progress in

the spring and mid summer period and reflect 'available water determinations' as announced by the NSW Office of Water.

In developing the basin plan, it is important to recognize the different levels of planning across States and the level of community and government investment and development in Watering Sharing plans, both surface and groundwater. It is not possible to apply a 'one size fits all' scenario or set of presumptions in regard to the complexities of the Murray Darling Basin.

The Murray-Darling Basin Cap

The Murray Darling Basin Agreement (Schedule F) defines the Cap for New South Wales (NSW) as:

> 'The volume of water that would have been diverted under 1993/94 levels of development plus an allowance in the Border Rivers for Pindari Dam.'
>
> The Cap in NSW and Victoria is not the volume of water that was used in 1993/94. Rather, the Cap in any year is the water that would have been used with the infrastructure (pumps, dams, channels, areas developed for irrigation, management rules etc) that existed in 1993/94, taking into account the climatic and hydrologic conditions that were experienced during the year under consideration. A primary task in monitoring the cap in these States is determining the size of the Cap target for each year. This calculation is done at the end of each year and uses the observed climatic and hydrologic data.
>
> In the south of the Basin, this will tend to result in lower Cap targets in years when there is significant rainfall in the irrigation areas and larger Cap targets in years with less rainfall when the demand is higher. However, the annual Cap target will also be affected by the availability of water. In very dry years in the south of the Basin, the annual Cap target will reflect the resource constraints. In the North of the Basin, the Cap target will be very much affected by the opportunities to harvest water into on-farm storages.
>
> Because of the these complexities, the calculation of the Cap targets is made by use of computer models with relationships for water use that include a range of climatic factors and detailed modeling of flows and storage behaviour.' (Note: the Murray Darling Basin Commission – Water Audit Monitoring Report (2006/07) published June 2008,

The Murray Darling Basin Commission – Water Audit Monitoring Report (2006/07) published June 2008, reference is made to all states under the Basin Cap (NSW, Victoria, SA, Queensland, ACT):

> 'Murray Darling Basin Auditing and approving these models is a major task. Interim Cap models have been developed for most Cap valleys, for which Caps have been agreed. Out of twenty four Cap valleys, Caps have not defined in five valleys and three other valleys do not require a Cap model. Of the remaining sixteen Cap valleys, Cap models have been approved for five; two more Cap models are ready for approval and eight Cap models are currently being audited. There is only one valley (wimmera-mallee Victoria) where a Cap model has not been built. But that valley has significant credit based on long-term Cap.
>
> The annual Cap targets, calculated with the help of Cap models are adjusted for water trades and environmental use of water if applicable'

The most current Cap review is the June 2008 Water Audit Monitoring Report 2006/07 – Report of the Murray-Darling Basin Commission on the Cap on Diversions.

3.5.1 New South Wales states:

> 'The interim Cap models for most of NSW valleys are available now. The Lachlan and Namoi models, after an audit, have been approved by the Commission under Schedule F. Following an audit, the NSW Murray Cap model (contained I the MSM suite of Cap models) has been recommended by the auditor for approval by the Commission. The Macquarie, Peel Gwydir, and Murrumbidgee models are being audited and are expected to be accredited by the Commission during 2007/08.
>
> Diversions in Gwydir, Namoi/Peel, Macquaire/Castlereagh/Bogan, and Murray exceeded their annual Cap targets and diversions in Barwon-Darling/Lower Darling, Lachlan, and Murrumbidgee valleys were within the annual Cap target for 2006/07. All NSW valleys, except Barwon-Darling/Lower Darling, are in cumulative credit. The cumulative debit of 57GL in the Barwon-Darling/Lower Darling, combined Cap valley was less than 62GL (20% of the long term cap) required for special audit. As a consequence on the recommendation of the IAG, Commission meeting 95-22 April 2008 revoked the declaration of Cap breach. [30]

National Water Initiative (NWI) – NSW Water Sharing Plans

The State of New South Wales has implemented a range of principles established under the National Water Initiative. Water sharing Plans have been implemented for the major regulated water sources within the Murray Darling Basin Plan. Macro Water Sharing Plans for unregulated surface and some groundwater water systems across NSW, are still to be completed.

What is a water sharing plan?

NSW Department of Water & Energy identify:

> "for our rivers and groundwater systems to be healthy and productive in the long term, it is critical to balance the competing needs of the environment and water users. A water sharing plan is a legal document prepared under the Water Management Act 2000 (NSW). It establishes rules for sharing water between the environmental needs of the river or aquifer and water users, and also between different types of water users such as town supply, rural domestic supply, stock watering, industry and irrigation."[31]
>
> "The purpose of a water sharing plan is:
>
> 1. to protect the fundamental environmental health of the water source
> 2. to ensure that the water source is sustainable in the long-term
> 3. to provide water users with a clear picture of when and how water will be available for extraction
>
> "Plans can be prepared as either an individual plan covering a specific river or groundwater system or a macro plan covering a number of rivers or groundwater systems."

[30] MDBC Water Audit & Monitoring Report (2006/07)

[31] NSW Dept Water &Energy – Water Sharing Progress Report

Major elements of a water sharing plan include the following points in relation to the environment:

- provides water for the environment by protecting a proportion of the water available for fundamental ecosystem health and/or including specific environmental rules – this is called planned environmental water
- allows licensed water to be committed for environmental purposes – this is called adaptive environmental water which can arise from water recovery projects or by buying water licenses
- protects the water required to meet basic landholder rights
- set annual limits on water extractions to ensure that water extractions do not increase and therefore erode the water for the environment and also the security of supply to water users – this includes the limit on extractions imposed under the Murray Darling Basin Cap
- specifies rules in groundwater plans to minimize impacts on other groundwater users, dependent ecosystems, water quality and the stability of the aquifer"[31]

How do these plans provide water for the environment?

NSW Department of Water & Energy identify: "Environmental rules in the water sharing plans are designed to:

- limit extractions so that the major share of water is protected – between 56 per cent and 80 per cent of the average annual water in the regulated systems will be retained in the river – amounting to over five million megalites (1 megalite=1 million litres) in the inland systems
- replicated natural flow patterns so as to provide water when and where it will best meet environmental needs – on average the rules for the regulated rivers will return an additional 220,000 megalitres of water to the environment over and above that required under the Murray Darling Basin Cap.

The environmental flow rules are based on the following river flow objectives that set out 12 aspects of flow considered to be critical for the protection or restoration of river health, ecology and biodiversity. These objectives were subject to extensive public consultation and endorsed by the NSW Government in 1999.

1. Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flow
2. Protect natural low flows
3. Protect or restore a proportion of moderate flows, 'freshes' and high flows
4. Maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems
5. Mimic the natural frequency, duration and seasonal nature of drying periods in naturally temporary waterways
6. Maintain or mimic natural flow variability in all rivers
7. Maintain rates of rise and fall over river heights within natural bounds
8. Maintain groundwater within natural levels, and variability, critical to surface flows or ecosystems
9. Minimize the impact of in-stream structures
10. Minimize downstream water quality impacts of storage releases
11. Ensure river flow management provides for contingencies
12. Maintain or rehabilitate estuarine processes and habitats[31]

[31] NSW Dept Water & Energy

NSW Water Quality and River Flow Objectives are the agreed environmental values and long-term goals for NSW's surface waters. Water Quality objectives have been agreed for Fresh and Estaurine surface waters and Marine Water Quality Objectives. The Objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC 2000 Guidelines.[32]

The purpose of river flow objectives are to produce specific environmental benefits such as:

- Improved survival of ecosystems and aquatic biodiversity
- Improved water quality
- Healthier wetlands
- Improved habit quality and increased variability of habitat for native fish, frogs, waterbirds and other native fauna, including invertebrates
- More successful breed of native birds, fish and other native fauna, which only breed in response to specific environmental triggers, for example, rising or falling water levels in the natural season
- More natural inundation of flood plains and wetlands, leading to better health and productivity (such as grazing), protection of endangered species, biodiversity and water quality
- Discouragement of alien pest species, such as carp, which favour regulated conditions
- Improved health of in-stream and riparian vegetation, leading to greater bank stability, improved efficiency of buffer strips in protecting water quality, and reduced erosion and turbidity
- Reduced frequency of algal blooms

The actual environmental flow rules in the water sharing plans for the regulated rivers vary from valley to valley, depending on which of the above objectives were considered most important for that valley. The range of rules which apply are set out in the table below:

Environmental flow rules in the regulated rivers	**Purpose**	**Valleys where rule applies**
Extraction limit	Sets a limit on the long term annual volume of water that can be extracted, thus protecting the major share of water for the environment	All regulated rivers
End-of-system flow	Requires a flow to be retained at the end of river system. This ensures that flow is maintained below the areas of major extraction	Namoi Murrumbidgee Hunter
Transparent dam release	Requires all dam inflows occurring at certain times to be passed immediately downstream, as though no	Murrumbidgee

[32] NSW Dept of Environment:

	dam was present. This maintains natural flow variability for that part of the year (usually winter months) when dam releases would otherwise be minimal	
Translucent dam release	Requires a proportion of dam inflows occurring at certain times to be passed immediately downstream. This restores the natural flow variability associated with specific flow ranges usually freshes and minor floods	Lachlan Macquarie
Limits on taking high flows	Limits pumping when the dam spills or high flows enter the regulated river from unregulated tributaries. This protects either some or all of these naturally occurring high flows which are important for flooding of wetland areas.	Lachlan Namoi Gwydir Hunter
Limits on taking low flows	Limits pumping from lower flows that enter the regulated river from unregulated tributaries. This ensures that sufficient water is retained in the river for the environment	Gwydir
Environmental water allowances or releases	Creates a 'bank' or volume of water stored in the dam which can be released for specific environmental purposes, such as flushing blue-green algal blooms, reducing salinity or supporting bird-breeding or fish spawning events.	Gwydir Macquarie Lachlan Murray Murrumbidgee Hunter

Note: there have been concerns about the application for rules of translucent flows and the risks of early translucent releases – which could accentuate the risks of storage not filling in the event of season inflows not meeting expectations.

Water Sharing plans progress – Murray Darling Basin Drainage Division (NSW)

Plan	**Area**	**Status of plan (as at 30.6.10) (year)**

Barwon Darling	7128 km2	In progress
Border River Regulated	3796 km2	2009
Border River unregulated & alluvial GW	20,148km2	Under development
Gwydir River - regulated	6556 km2	July 2004
Gwydir River - unregulated	19,498 km2	July 2004
Gwydir – Groundwater		2006
Castlereagh River	17,401km2	2004
Macquarie & Cudgegong Regulated Rivers		2004
Castlereagh River above Binnaway Gazetted Plan		2004
Macquarie & Castlereagh Unregulated & Alluvium		Under development
Lower Macquarie Groundwater		2006
Darling River regulated	3081 km2	2004
Darling River upper unregulated	58,795??	In progress
Far West	95,562	Not planned * identified requiring plan
Lachlan River - regulated	(59,891km2)	Commenced 1st July 2004 Suspended 1 July 2004 (drought -critical planning)
Lachlan River - unregulated Mandagery Creek		2004
Lower Lachlan – groundwater		2008
Lachlan – Belubula regulated & alluvial		Under development
Lachlan – Unregulated & alluvial		Under development
Lake George	941 km2	In progress
Lower Murray Darling	76,766 km2	In progress
Macquarie River regulated	12,284 km2	2004 Suspended July 07 (drought)
Macquarie River unregulated	61,673 km2	In progress
NSW Murray – Lower Darling Regulated Rivers	18,593 km2	2004 Suspended 10 November 06 (drought- critical planning)
Upper Billabong		2004
Lower Murray Groundwater		2006
Lower Murray shallow Alluvium		Under development
Murray Unregulated & Alluvial		Under devleopment
Murrumbidgee River regulated	29,271 km2	2004 Suspended 10 November 06 (drought – critical planning)
Adelong Creek – unregulated		2004
Tarcutta Creek - unregulated		2004
Lower Murrumbidgee Groundwater		2006
Lowbidgee Floodplain - unregulated		Under development
Murrumbidgee Unregulated & Alluvial		Under devleopment
Upper Namoi & Lower Namoi – regulated	7444 km2	2004

Peel Valley regulated, unregulated, alluvium & fractured rock source		2010
Phillips Creek, Mooki River, Quirindi & Warrah Creek		2004
Upper & lower Namoi Groundwater		2006
Namoi unregulated & alluvial		Under development
Upper Murray	5207 km2	Not planned *identified requiring plan

(source National Water Commission & NSW Office of Water)

NOTE: NSW has approximately 23 other identified regions outside the Murray Darling Basin drainage division currently developing/developed water sharing plans

The National Water Commission – Water Environmental Water Management Report 2010 states:

> "The Commission recognizes that the establishment of the water requirements of the environment and the subsequent provision of water through water plans – following the trade-off process with other public benefit outcomes and consumptive uses – does not lend itself easily to volumes and 'water balances'. Environmental water requirements necessarily involve issues of timing, water quality and dynamic flows – an overall regime that is difficult to represent numerically that poses a significant challenge in water resource accounting".

The report concludes:

> "the determination of environmental water requirements has improved from focusing on base flows, to more sophisticated methods that consider components of the entire water regime"

The NWC report (2010) Section 6.2 – determination of environmental water states for NSW:

"**Environmental outcomes are specified in the water sharing plans. Water requirements to achieve those objectives are not stated, however they are to an extent implicit, in the water management rules set out in the plans.**

Environmental flow rules in initial surface water plans were developed based on 12 broad 'river flow objectives' and the environmental flow rules were tailored to reflect the ecological, hydrologic and water quality conditions in each water source.

The report Section 6.5 – Review of environmental water states:

"for the regulated river plans, NSW has adopted an approach called 'Integrated Monitoring of Environmental Flows'. The program assesses the environmental water provisions of the water sharing plans for the major regulated rivers to:

- Investigate relationships between water regimes, biodiversity and ecosystem processes…; to assess responses in hydrology, habitats, biota and ecological processes associated with specific flow events targeted by environmental flow rules; to use the resulting knowledge to estimate likely long-term effects of environmental flow rules (planned environmental water) and provide information to assist in future adjustment of rules.
- The program is largely aimed at assessing the environmental water provisions of the water sharing plans to determine their effectiveness in meeting the ecological objectives of the plan

- Environmental water provisions in the unregulated river water sharing plans are different to those for regulated rivers. Generally, in unregulated rivers the environmental flow rules consist mainly of annual extraction limits and 'cease to pump' levels which prevent pumping when river flow drops below a specified level.
- For unregulated river plans, monitoring is undertaken over a number of stands which largely focus on low flow issues. These strands examine issues such as fish passage, predictive modeling of fish and macroinvertebrates, low flow vertification, pool refugia, and inflows to estuaries.
- Some groundwater sharing plans include provision for recharge calculations and the proportion of recharge identified as planned environmental water to change throughout the life of the plan. Monitoring and modeling of groundwater condition is used to inform such changes. This information will also be used to assess outcomes of these plans at the end of their term.

Water Sharing Plans – How water is allocated

The NSW Government allocates water on the following basis in regulated Southern connected systems.

- High security - (includes town water supply, industrial, stock & domestic, and high security license conditions for agriculture)
- General Security – water availability varies annually or seasonally
- Basic Water Rights – eg Stock & domestic
- Conveyance Losses – water held by license to ensure delivery of consumptive water
- Adaptive Environment water – water held under license specifically for the environmental
- Supplementary access – announced when water flows are in excess of rules specified in a water sharing plan

Water Sharing Plans – Priority for water allocation announcements

In NSW, allocation announcements for the Murray and Lower Darling Rivers are based on the following priorities in order:

1. flow required to meet environmental health requirements
2. provide for basic water rights
3. provide for water carried over from previous year
4. provide for high security entitlements
5. provide for initial conveyance losses
6. provide for general security entitlements
7. announced supplementary water

Water Sharing Plans – specific environmental considerations.

Water Sharing Plans (WSPs) vary across regions. Operational rules are determined by a range of factors including, the water source, environmental considerations, end of system requirements and licensed entitlements. Some WSPs may have specific rules in addition to the NSW River Flow and Water Quality Objectives.

An example of this occurs in the NSW Water Sharing Plan for the Murray and Lower Darling Regulated Rivers 2003 where planned environmental water rules exist for the Barmah-Millewa Allowance.

Murray Irrigation Limited (MIL) – formerly a NSW Government water distribution entity and now a private irrigation company, is a private irrigation distribution company whose area of operations is from Mulwala (east) to Moulamein (west). The area of operation covers 748,000 hectares of farmland on the northern side of the Murray River in the Southern Riverina region of New South Wales.

Investments and partnerships arrangements with the Government, have seen the accrual of benefits to the environment, achieved through investments in infrastructure.

Through investments for water saving infrastructure in the areas of MIL operations, environmental benefits were delivered through the NSW Lower Murray Darling Water Sharing Plan. This included the creation of a permanent water entitlement of **100,000 ML** for the Barmah Millewa Forest (Murray River Icon site) (50,000ML NSW/50,000ML VIC)

A further 50,000 megalitres (25,000ML NSW/25,000ML VIC) can be accessed under certain conditions. This forests entitlement is delivered as a result of Government/community plans developed to deliver ecological benefits for the forest and its environs.[33], [34]

A further investment in channel upgrades, saw an additional 30,000 ML form part of the adaptive environmental water – in the NSW Murray Lower Darling Water Sharing Plan.

Regional cross border water sharing plans (in Victoria and NSW (NSW Lower Murray Darling)) enable the water accounts to built up in the plan. This can mean, the environmental entitlement for the Barmah Millewa totalling up to 700 GL, can be stored over successive years. This specified environmental water for the Barmah Millewa identified in the WSP can be released in a larger volume to maximize the environmental benefits but significant issues related to the storage and release of this scale of environmental water (ie account @ 700 GL).[34]

In 2005/06, the Barmah Millewa environmental water account released 512,000 ML into the Barmah Millewa Forest in the middle of the 'Millenium drought'.

Water Sharing Plans – environmental benefits achieved through the delivery of consumptive water

Environmental benefits are derived through the delivery of entitlements prescribed under a water sharing plan. As an amount of water allocated for specific purpose in a Water Sharing Plan, is released from a water storage system (eg Hume Dam), benefits accrue to fish species, macro invertebrates, bird, mammals and vegetation, as 'entitlements' move through the river, creek or channel systems. Such benefits are in addition to specifically identified environmental benefits achieved through rules of a water sharing plan (planned environmental water); benefits achieved through specific 'environmental entitlements' (adaptive environmental water); or other specific environmental purchases or conditions.

Water Sharing plans establish the bulk access regime for extractable water under access licenses. For example the Water Sharing Plan for the Murray and Lower Darling Regulated Rivers 2003, include the share component:

- stock and domestic access licenses

[33] Murray Irrigation Limited

[34] NSW Office of Water – NSW Murray & Lower Darling Water Sharing Plan

- local water utility access licenses
- regulated river (high security) access licenses
- regulated river (conveyance) access licenses
- regulated river (general security) access licenses
- supplementary water access licenses

Note: Supplementary license conditions can be determined by the relevant NSW Minister. In wetter periods, water in excess of planned requirements or of storage capacities, may be activated as supplementary licenses (all/or part). Supplementary licenses not accessed, are retained in the river system for the environment as is experienced in 2010. Flows pass through the river system but are not categorized as 'environmental flows'

Originally water planning enabled general Security entitlements to access up to 455 GL of Supplementary Water, which was approximately 20% of water use. In 1996/97, NSW **imposed a ceiling of 250 GL**.

The rules around the delivery of 'consumptive or licensed water', developed under a Water Sharing Plan, have a range of inbuilt rules for the protection of the environment as noted in the previous section.

However, what is not noted or evaluated, in considering the needs of the environment, are the benefits derived for the environment, through the delivery of 'consumptive or licensed water'. Accrual of benefits can be assessed through in river, stream or tributaries flow, channel distribution networks or, ultimately as water is distributed for agricultural, for the production of food or fibre.

(photos: Black Swans & cygnets - L Burge Breeding in MIL irrigation channel width of channel 4 m)

(Photo: Brolgas in the Riverina L Burge)

The Southern Riverina region of NSW is a diverse agricultural region producing wheat, sheep, beef, dairy, rice and vegetables. While the region hosts the largest rice mill in the Southern Hemisphere, farms producing rice, do so on a rotational basis with other cereal and livestock enterprises. Farming areas, such as the Southern Riverina, that have seasonal water sources, attract a significant level of biodiversity than is increasingly recognized for its contribution to the environment.

The rice growing region of Australia have become part of The East Asian-Australian Flyway Zone – an international flyway corridor for migratory journeys of many bird species, including water birds that would otherwise not be seen in this part of the world.[35]

Research has shown that around 40 billion frogs are found on rice farms throughout the Riverina. The Endangered Southern Bell Frog relies on the rice industry for its survival[36] [37]

[35] Ricegrower's Association of Australia

On going research by the University of Canberra at the Rice Research Field Station at 'Old Coree' (Jerilderie), have determined that approximately 4000 frogs live in 0.3 of a hectare. It is estimated that frogs comprise the highest biomass of any vertebrate in the rice based systems of the Southern Riverina.


(Photo: J Burge)


(photo J Burge)


(photo: RGA)

In assessing additional water for environment purposes, environmental benefits achieved through the delivery and use of consumptive or licensed water, should be recognized as providing significant benefit to a range of environmental factors.

Major Storage Dam – spills (flood)

The Hume Dam water levels vary in relation to climatic conditions affecting inflows and demand. In the months of November through to April, a drawdown of the Hume Dam water supplies at the end of the irrigation season mean that typically the Hume storage capacity is between 10% and 50% of capacity. The efficiency of the catchment of the Hume Dam, means that despite relatively low volumes at the end of a season (ie 10%), in normal conditions the Hume Dam can reach capacity within a relatively short timeframe (often < 5 months).

Seasonal inflows are stored during the winter and spring to provide reliable water security for urban, irrigation, industrial and tourism needs during warmer months. Depending on seasonal conditions and inflows, the Hume Dam may spill naturally as inflows exceed storage capacity. This can occur on average, one year in two, or at the other extreme, no spills - in dryer periods.

There are four main phases of operation of Hume storage:

- Filling phase
- Release phase
- Pre-release phase
- Spilling (flood) phase

When seasonal inflows exceed demand and storage capacities, the spillway gates at the dam are used, together with the power station and irrigation valves, to pass inflows downstream.

The aims of the operation are:

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[36] Pyke G,
37 Doody JS

- To pass the flood without endangering the safety of the dam
- To mitigate, or at least not worsen, the effects of downstream flooding
- To ensure as far as possible that the storage is near full after the flood so there is no loss of resource[34]

Overall, the Hume Reservoir provides very significant flood protection downstream. It can fully absorb many floods during the filling stage, typically during autumn and early winter, and significantly mitigate later floods. However, once the storage has filled, its flood mitigation potential is very limited until it is again drawn down[34]

Water that is released in the spill (flood) phase is likely to occur when the catchments are significantly wet and the demand on water supplies for consumptive purposes is limited as has occurred in 2010.

Spill (flood) events passing through the Hume Dam can contribute major inflows to the river system. These significant flows will pass through the environment, but may not officially recognized or classified as environmental flows.

Murray River – South Australia Conveyance rules

South Australia's has a share of the Murray Darling Basin Water resource that is determined as a base entitlement flow of 1850 GL/year.

In order to ensure this entitlement flow can be delivered throughout the year, additional water is provided to cover losses and evaporation.

Approximately an additional 696 GL is used to ensure the delivery of the minimum entitlement flows to South Australia.

Dilution & Loss flows – South Australia

In the NSW Murray and Lower Darling Regulated Rivers Water Source Plan 2003, specific operational rules apply. An example is additional conditions as they relate to the Murray Darling Basin Agreement and interstate water sharing arrangements for environmental management of the Murray-Lower Darling Rivers

South Australia (SA) has an entitlement share of 1850 GL. This entitlement includes a flow value of 696 GL as a dilution and loss factor, in the delivery of the base entitlement (1850 GL).[13]

Following the 1987 MDBC Salinity and Drainage Strategy, in 1992 an amended agreement on the waters of the Murray Darling Basin, provided further flows to South Australia as additional dilution flows, to keep salinity levels below 800 EC. Modelled predictions for salinity lead to this further dilution flow.

<u>This particular rule did not undergo consultation with the irrigation community as would normally occur and therefore is relatively misunderstood.</u>

[34] NSW Office of Water
[34] NSW Office of Water
[13] SA Government – Long Term Plan CLLMM

The additional South Australian 'dilution flow' of 3000 ML/d, is an automatically triggered release rule, when "the storage volumes in the Menindee Lakes exceed nominated trigger points, at the same time as the combined storage volumes of Hume and Dartmouth Reservoirs, also exceed nominated triggers.

The trigger volumes are determined when the Menindee Lakes has a volume of 1300 GL and the combined Hume and Dartmouth storage dams have reached a 1000 GL each. Once the 'dilution flow' is triggered, then flows will be released from Menindee and continue until the NSW reserve is reduced to 480 GL. It is difficult to determine, but there appears to be no mechanism in place to stop these additional salinity 'dilution' flows from commencing or ceasing until the NSW 480 GL is reached, even if salinity levels are not an issue. *(note: Menindee triggers increase in June/July/August*)

At the time of determining this rule, Australia was in the grip of the 'salinity crisis' where modeled predictions for salinity projected increased risks to the Murray River and supplies to South Australia.

Note: Salinity levels at Morgan, (official salinity reading site) have remained within or well below the World Health Authorities (WHO) raw drinking water standards of 800 EC.

The Menindee Lakes play a significant role in storing waters from the Darling system to augment South Australian entitlement flows. If Menindee falls below set volumes, then South Australian entitlements must be sourced from the Murray River storages.

In August 2010, when salinity at Morgan was approximately 240 EC, Menindee, Hume and Dartmouth volumes had reached the 'dilution' trigger points. Approximately 3000 Ml/d was released from Menindee.

In 2010, this rule did not cause adverse impacts on River Murray storages as continued inflows into Menindee from the Darling kept the storages full. However, if the Darling River inflows to Menindee has ceased, the 'dilution' rule still would have been in place, releasing up to 3000 ML/d, with no mechanism to switch it off until the NSW storage reserve had been reached (480 GL).

In determining the amount of water that is available for the environment, it is not clear if the additional 'salinity dilution' flows to South Australia, are captured in reports, as water for the environment. The original target objective of ensuring EC levels at Morgan are kept within 800 EC, is now not the primary causes for triggering the 'dilution' releases from Mendindee, rather its when storage volumes are met.

Snowy Hydro rules – compulsory release

Snowy Hydro Limited is required as per the Snowy Water License to release a minimum of 1,062 GL from May to April into the Murray River system. On average though, approximately 1210 GL is released into the system. It is also required to release 1062 GL in the same period to the Murrumbidgee River system through releases into Blowering Dam.

These releases contribute to flow contributions and underpin river operations and entitlements.

The requirement to release as part of the license rules, is for the most part, required in the normal river operations. However, as in 2010, when substantial inflows have occurred and demand for 'irrigation water' is low, the license conditions may require the mandatory releases of set volumes within the defined periods.

In 2010, it is likely that such releases will not be utilized by for consumptive purposes, or required as part of the overall river operations. Therefore these additional flows, if released, will form part of environmental flows that are not recorded as such and therefore not accounted for in environmental flows.

Other Programs or Environmental provisions

The environment has received further benefits with major Government investments and programs. These are additional to benefits derived under NWI Water Sharing Plans and other State or Federal controls such as the Cap.

Programs can take the form of direct purchase of water entitlements to be reallocated for environmental or through investments in infrastructure to improve water delivery and use systems.

In conjunction with environmental shares for water being delivered through the Murray Darling Basin Cap on Diversions, the National Water Initiative State delivered Water Sharing Plans, there are a range of other mechanisms where benefits to the environment occur.

> "The Department of Environment Climate Change and Water (DECCW) manages planned environmental water (established through provisions of a Water Sharing Plan) and adaptive environmental water (held as Water Access License by the Minister for Climate Change and the Environment and others). DECCW may also manage environmental water owned or acquired by other parties, including non-government organizations." "opportunities for environmental watering, at target sites across the State, depend on the availability of environmental water and the likely ecological response to water at any given time."[32]

Adaptive Environmental Water Plans are prepared by DECCW and approved by NSW Office of Water (NOW). Adaptive environmental water plans are determined when water is acquired or recovered for the environment and is held under a license. [32]

Adapative Environmental Water Plans have been prepared and approved for:

- Gwydir
- Macquaire
- Lachlan
- Murrumbidgee [32]

These regions have been identified within the NSW Government RiverBank program as " target valleys for environmental watering. Plans are linked to the objectives of the relevant Water Sharing Plans". [32]

Living Murray

[32] NSW Government – DECCW Environmental Water Planning (website)

The Living Murray Initiative is a major environmental program by the NSW, Victorian, South Australian, Act and Commonwealth Government to improve the environment health of the Murray River. This is achieved by recovering 500 GL of water.

The Living Murray seeks to recovery water and invest in environmental works and measures for six icon sites:

- Barmah- Millewa Forest
- Gunbower and Perricoota-Koondrokk Forests
- Hatta Lakes
- Chowilla Floodplain (including Lindsay and Wallpolla Islands)
- Murray Mouth, Coorong and Lower Lakes
- River Murray Channel

$700 million is being invested to recover water to improve the environmental health of six significant ecological sites along the Murray, namely the Barmah Millewa Forest; Perricoota-Koondrook and Gunbower Forest; Hattah Lakes Complex; Chowilla wetlands and floodplain; Coorong and the Murray Mouth; and the main channel of the Murray River. Another $150 million is being spent on environmental works and measures.

The NSW target is to recover 249 GL for the environment and the NSW Government has completed or commenced work on a number of projects. By June 2010 197 Gls has been recovered in NSW. Completed projects include:

1. The $54 million Great Darling Anabranch Pipeline Scheme which involves the removal or modification of block banks and other water regulation structures which create a series of water pools and the installation of pumps, a pipeline and filtration system. This will save 47GL of water and allow the re- introduction of more natural flow conditions along the 460 kilometres of the Great Darling Anabranch.
2. The purchase of 12 GL of irrigation entitlement from the Poon Boon Irrigation Trust.
3. Edward River Savings Stage 1 which involved the construction of 18 regulators to stop unwanted flooding of the Millewa Forest saving 7.1 GL
4. Construction of a regulator to better manage the regulated flow to prevent unnatural flooding of Croppers Lagoon saving 8 GL.[32,34]

The Living Murray program (NSW) purchase of 100 GL of supplementary water shares in the Murray Water Source, saw 17,800 ML (estimated long-term extraction associated with 100 GL) retired per year from the NSW Murray Bulk Access regime.

In the Lower Darling Water Source, the 250,000 shares of supplementary water also purchased under the same program, saw 35,500 ML per year retired from the bulk access regime.

Barmah Millewa Forest entitlement

In 1990 the Murray Darling Basin Commission (MDBC) provided $400,000 for a consultancy to review the water needs of the forests, investigate options for meeting the water requirements and to develop a comprehensive water management plan. The Barmah Millewa Community Reference Group (CRG) was formed as a ‘result of that study’.

[32,34] DECCW & NSW Office of Water

The CRG identified specific concerns for the future management of the Barmah and Millewa forests.

It was identified that the forest ecosystem was 'suffering significant **under-watering** AND **over-watering** in different parts of the forest. This occurred because:

- Regulation of the river (ie. Water storage and release)
- Lack of water-control structures to let water into the forest when required
- Lack of water-control structures to let water out of the forest when required
- Lack of water-control structures to keep water in the forest when required
- Lack of water-control structures to keep water out of the forest when required
- Lack of water-control structures within the forest, to spread water over the forest floor (to mimic natural flow patterns)[36]

The report went on to say "water supplied to the forest will be largely in-effective, unless there is a comprehensive system of river-bank and internal water-management –structures. In fact, extra water for the forest without these water-management structure" [36]

The plan of management identified two sources of water supply seasonal flows (non stored water) and stored water (eg Hume Dam).

In seasonal flow scenarios (known as 'low river-flow") it was not necessary to water the whole forest-ecosystem 'any one time'. Defined Water Management Areas would be watered on a 'rotating priority system'. Almost 1/3 or 38% of the forest-ecosystem can watered under this scenario.

In stored water flow releases (ie from Hume), proposals to water would be based in two phases (1st & 2nd releases) and on three conditions. The first release included up to 265 GL/mth for 'managed floods' and provisions around flood flows from the Ovens and Kiewa Murray tributaries, the combined storage volumes of Dartmouth and Hume Dams and the need to recognize the capacity constraints for such released in the Hume and Yarrawonga river channel. The report notes that based on 'historical weather simulations', this would occur about 2 years in 10.

The second release up to 50GL/year was to ensure environmental benefits from forest areas watered by the seasonal or (low river flow) events. This type of release could occur about '7.4 years out of 10 on average'

The CRG report recommendations included:

- a five year program for construction of water management structures (approx $650,000 /yr).
- water part of the forest ecosystem at a time, when appropriate, rather than the whole forest

The CRG noted that:

- there is no single solution to watering the forest (the Water Management Plan must be flexible)
- controllability of water into, out-of and within the forest is vital (due to roads, tacks and levees). "Hence the term 'Water-management plan' and not just 'Water plan'.

[36] Barmah Millewa CRG

- The forest's "watering is already managed and has been for over 50 years. What's proposed is BETTER water-management"
- Money for Water management plan is just as critical as water supply. "In short, supply of water by itself will **not s**olve the forest's watering problems

The Barmah Millewa Forum (community reference group), developed recommendations for water requirements for the Barmah Millewa forest in their Final Report – Barmah Millewa Forest Water Management Plan - (11th February 1994).

Governments did not implement the recommendations despite strong community support and a united committee endorsement. Government decisions indicated a preference to obtain 'more water' for the forest, rather than invest in infrastructure to enable proposed water plans to be implemented efficiently.

The initial CRG plan only proposed 50,000 ML of specific environment water, plus investments in regulators to efficiently deliver water and alternating watering events on both sides of the border. (NSW & Vic)

The Barmah Millewa Forest today, has an environmental water entitlement of 100,000 ML (Murray River Icon site) (50,000ML NSW/50,000ML VIC). This entitlement (100 GL) is specifically noted in the relevant NSW Murray and Lower Darling Water Sharing Plan.

A further 50,000 megalitres (50 GL) (25,000ML NSW/25,000ML VIC) can be accessed under certain conditions.

Barmah Millewa can store up to (700 GL) 700,000 ML in its account, however the accumulative account rules, however this can have some adverse operational risks. To store 700 GL equates to approximately 23% of the total Hume Dam.

The Barmah Millewa Forests are listed under the International Wetland Ramsar Convention – the Barmah (Victoria) in 1982 and the Millewa (NSW) in 2002.

The Barmah Millewa Forest was also an identified beneficiary under the $700 million Living Murray Project involving the recovery of 500 GL of water for the environment. Due to the severity and extent of the drought, water recovered under the Living Murray project has not been made available to the environment because of low inflows to storages.

However, in 2004/05, the Barmah Millewa forest did receive 512,000 ML of water as part of its water entitlement recognized in the NSW Murray and Lower Water Management Plan.

Before the watering event in 2004/05, throughout the 10 years prior, the forest received natural flood events five times during the period 1990 to 2000. (*note: despite this the MDBA Guide notes that only 20% of the forest is in healthy condition)*

In December 2009, the Natural Resource Commission (NRC) headed by Dr John Williams, (member of the Wentworth Group), released its Riverina bioregion Regional Forest assessment for the River Red Gums and Woodland Forests.

The NRC undertook the assessment on behalf of the NSW State Government as part of the regional forest agreements for future forest management.

The NRC report included:

- A transborder national park (Barmah Millewa)
- Significant water reforms

The NRC identified that about '54% of the long term, pre-development, mean annual flow at Yarrawonga (or 2000 GL)' would be required for the Murray river system ecosystem'. [37]

The report notes that to achieve this, will require the Murray Darling Basin Authority to set the relevant sustainable diversion limits under the Basin Plan.

Of the 2000 GL recovered through new sustainable diversion limits, 1200 GL was recommended to be specifically utilised for the Murray system. 1200 GL equates to approximately one third of the Hume Dam (3038 GL). [37]

The NRC recommendations were to be in addition, to water recovered for this forest as part of the Living Murray Project and the existing Barmah Millewa water entitlement of 100 GL plus another 50 GL under specific rules.

Koondrook-Perricoota Forest Flood Enhancement Project

The Koondrook (Vic)-Perricoota (NSW) forest site is a part of the Living Murray Initiative set up by the Murray Darling Basin Ministerial Council. (2002) The Forest is located on the Murray River between the towns of Echuca and Barham.

Under the program for Environmental works and measures, a channel is to be constructed "Torrumbarry Cutting" to enable forest watering to occur in non flood river levels.

The NSW Office of Water is the project director for the delivery of the Living Murray environmental works and measures program in NSW. Construction of the $57.7 million Koondrook-Perricoota Forest Flood Enhancement Project will divert water into and reinstate flooding in the forest.

The Koondrook-Perricoota Forest covers about 32,000 ha and is part of the second largest River Red Gum forest in the world.
The works include:

- Inlet regulator and a 3.8km diversion channel from the Torrumbarry weir pool
- Upper forest regulators
- Return channel to the Murray River
- Lower forest regulators
- Associated levee banks

Note: fish passages will be incorporated into structure design

It is estimated that the project will deliver, during a flood event, an initial flow of 6000 ML/day will be sustained for 50 days and then 3,400 ML/day for a further 50 days. Some 250 GL will be used in the forest in any one watering, with the remainder being returned to the Murray River.

37

The total assumed water requirement for the forest is 466 GL with an expected use within the forest and evaporation and infiltration use of 225 GL. It is estimated that if the maximum volume was used (466GL), then 222 GL would return to the river. [38]

State Forest in their Preliminary Environmental Assessment (Part 3A application) suggest that this would water up to 50% of the forest (16,000 ha).

The design capacity of the Torrumbarry regulator is estimate to carry 6,000 ML/day. The works and measures program has included provisions to enhance flood safety levees to adjoining properties, a river road bridge, fishways and a range of regulators to manage watering events.[38]

New South Wales (NSW) River Bank

The RiverBank Program in NSW is a program operated by the NSW State Government. This $105 million project utilizes funds raised from the NSW Waste and Environment levy. The funds raises go towards the purchase of water licenses for the benefit of the environment. Approximately 32,000 ML of water has been purchased in the Macquarie, Gwydir, Lachlan and Murrumbidgee Valleys

> "Access licences will be purchased in inland regulated river valleys and managed for specific and measurable purposes that benefit river and wetland assets of high ecological value. In many cases, these uses will also support Aboriginal cultural values. Targets for environmental watering include:
>
> - Macquarie Valley - vegetation communities in the south and north Macquarie Marshes Nature Reserve, private Ramsar sites, part of the property 'Pillicawarrina' and smaller wetlands on the Macquarie River system upstream of the Macquarie Marshes
> - Gwydir Valley - disconnected wetlands in public ownership, private Ramsar sites, 'the property Old Dromana', and in-stream environmental health
> - Murrumbidgee Valley - wetlands on the Lowbidgee floodplain, primarily within Yanga National Park
> - Lachlan Valley - Lake Ita, Murrumbidgil Swamp, small wetland assets on the mid- and lower Lachlan creeks, 'Booligal Station' and the Great Cumbung." (source NSW Office of Water web)

NSW Murray Wetland Working Group

The NSW Murray Wetland Working Group is a 'community wetland rehabilitation group' which was established approximately 1992 in the Lower Murray-Darling and Murray Catchments of NSW.

The NSW Murray Wetlands Working Group was nominated to manage approximately 30,000 ML of water entitlements achieved through the NSW Government investments in seepage and control works, within the channel systems of Murray Irrigation, a private water supply company in the Southern Riverina.

[38] NSW State Forests

The Group works closely with the relevant government agencies to determine water delivery for private and public wetlands. The adaptive nature of the group, mean that the base 30,000 ML entitlements, can be sold on the annual temporary market to raise funds for wetland infrastructure works.

Significant achievements have been realized by the Group and innovative solutions include the use of Murray Irrigation private channel system, to facilitate the efficient movement of environmental water onto private wetlands. In 2000, a trial involved the use of 26,000 ML of AEW, to prolong a flood event in the Barmah Millewa Forest.

Despite the onset of the very dry conditions, the Group has delivered environmental water to a range of private and public sites including, Wanganella Swamp, Werai State forest, Gulpa Creek Reed Beds and Swamp, Duck Lagoon, Pollack Swamp, to name a few.

Waters for Rivers - Snowy Initiative

The Snowy Initiative has been established to achieve significant improvements in environmental flows into the Snowy and Murray River systems. The Commonwealth, New South Wales and Victorian Governments committed $375 million to fund and commission water efficiency project to provide environmental flows. Of this the NSW Government is investing $150 million.

The targets include returning 212,000 ML, or 21 per cent of the average natural flow, to the Snowy River's first 30 km. This is the section of River determined to be impacted by the Snowy Mountain scheme. Below the first 30 km, normal river inflows occur. The Snowy Initiative also seeks to return 70,000 ML to the Murray River in a staged approach over 10 years. The Snowy Water Inquiry Outcomes Implementation Deed is a Deed that the three partner Governments entered into to give effect to the outcomes of the public Snowy Water Inquiry in 1998 and the corporatisation of the Snowy Scheme, and it includes these water recovery targets. [34]

<u>Waters for Rivers</u>
Water is recovered through investments in "water efficiency projects and other measures (including license purchases) to recover water for environmental flows. The June target for water recovery by Water for Rivers is 14 % of average natural flow (initial 30km river section of the snowy), equal to 142 GL. At 30 June 2009, Water for Rivers has recovered 197 GL (131 GL for the Snowy River), with around two thirds of the total water recovery being from within NSW". [34]

"Once a water efficiency project is complete, the recovered water is converted into a water entitlement. These entitlements then receive water allocations into their water allocation account as available water determinations are made in each river system. The water in these accounts is then used to provide environmental releases for the Snowy and Murray Rivers.?" [34]

"Environmental water in the Snowy River, is stored and then released to provide 'flushing flows'. This decision made during the Snowy Water Inquiry to assist with sedimentation transport. Works were constructed between 2003-06 to facilitate this flushing flows and while under construction, the first three years (2002-2005) were delivered through the

[34] NSW Office of Water

Mowamba River. Delivery of this water was made prior to full recovery of entitlement water and therefore the repayment of initial water released to the Snowy is referred to as the 'Mowamba borrow'."

"The allocation of water for environmental flows in the Snowy River in any year is prescribed in the SWIOID. Water available in the coming year, two-thirds is apportioned to the Snowy River and one-third is apportioned to the Murray River".[34]

On 11 August 2010, an agreement between NSW, Commonwealth and Victorian Governments allows for a total of 56 (or 62) GL in 2010-11 to be released into the Snowy River over the next two years. The agreement also enabled an immediate repayment of the Mowamba Borrowings Account that had been delayed due to drought.

[34] NSW Office of Water

In determining the needs of the environment, the MDBA has set targets for the recovery of water for the environment at:

3000 GL
3500 GL
4000 GL.

Prior to determining the basis for these additional requirements for the environment, it is important to assess the benefits for the environment achieved through existing water sharing arrangements.

The total resources available to the environment does not appear to have been evaluated prior to the assessment of more 'flow volumes' for the environment under the Basin Plan.

Major investments in the Living Murray and other environmental programs have also not been factored in the new environmental needs, determined by the MDBA.

In the event, that the MDBA claim, they have taken into account environmental benefits derived under NWI Water Sharing Plans, environmental programs such as Living Murray – it is difficult to ascertain how they have done so. The 'Millenium drought' has not enabled these processes and programs to be evaluated as low flow conditions experienced during severe drought, have prevented the delivery of water and therefore, appropriate analysis could not have been done.

It appears that without such evaluation, the set targets of 3000 GL, 3500 GL & 4000 GL are based on a perceived need in a specific location, rather than a more thorough analysis of environmental requirements for the Basin.

It is difficult to assess the basis for the additional environmental requirements prescribed by the MDBA Guide to the proposed Basin Plan, as the relevant Guide volumes, have been progressively released, with some only recently prior to the closing date of the submissions to the Guide. A number of technical documents relating to individual catchments are still not readily publicly available.

While the Guide and related volumes, indicate reference material, not all the reference material is available and the scale of the relevant volumes, short time frame for public accessibility and difficulty in location of specific information, makes public comment difficult.

Comments in this report, focus on the specifics of the Basin Plan from an environmental perspective.

In recognizing the considerable scale of water planning, including environmental achievements that have occurred, up to the Water Act 2007 and the development of the Basin Plan, further claims for the environment should undergo rigorous scientific analysis.

The MDBA have utilized a range of reports to support the proposed target options for water to be returned to the environment (3000, 3500, 4000 GL). The basis of some of these reports has been identified as a concern by the Basin Communities.

MDBA Baseline Data concerns

The Murray Darling Basin has relied and gathered information from a range of sources. This includes publications that date back to the beginning of a range of natural resource management reforms including the Salinity Audit.

There is considerable public concern that Australia, through its revised funding arrangements for science and research, has moved toward research, being more aligned to political policy objectives.

Due to the current funding arrangements, the shift in focus of research is probably now more closely aligned with attracting resource dollars, as Governments themselves, have set new boundaries in research, than previous research facilities, would have encountered.

This pattern has perhaps raised community doubts, about the influence of politics on scientific reports and the necessary need of relevant organizations, to attract funding. A perception exists that the 'independence' of such research could be compromised.

Murray Darling Basin Ministerial Council - Sustainable Rivers Audit (SRA) (2008)

There are significant concerns in relation to the reliance of the MDBA, on SRA 2008 report.

- Report prepared by the Independent Sustainable Rivers Audit Group (a group of independent ecologists)– for the Murray Darling Basin Ministerial Council (Peter Davies, John Harris, Terry Hillman, Keith Walker

- Report uses data gathered during period – 2004 to 2007 (MDB major drought period) on hydrology, fish & macroinvertebrates – report released in June 2008 (report notes – "1st step toward analysis of trends which will be a feature of later reports") *The reference to 'analysis of trends suggests that trends have been observed during a major drought.*

- Report itself notes: ' A severe drought has prevailed over the Basin during the Audit period – it is too soon to say how much this has affected fish & macroinvertebrates communities'

- The 'SRA is an audit, concerned with surveillance…….is concerned with signs of change of changes rather than causes'. (*note: this may suggest that drought impacts may not have been adequately considered)*

- 'SRA employs a concept of Reference Condition. This describes the patterns & processes that would be expected to prevail **now** had there been no significant human intervention in the landscape. It is open to some uncertainty, because it is estimated rather than measured' *note reference condition is not a target for management but is a comparison figure*

- Report itself notes: 'ecosystems are conceptual entities…… generalisations may be elusive and comparisons may be difficult. The 'health of an ecosystem cannot readily be judged by comparison with a database indicating 'normal' ranges for different variables, as ecologists do not have access to the kinds of reference data that a medical practitioner does'

- 'historical data, expert knowledge and modelling are used where possible, but sometimes these may not be sufficient for reliable estimates of some variables'

- The Audit reports are scheduled at 3 year intervals – to the MDB Ministerial Council. The 1st of these reports which indicates 'trends' has been a key supporting document in developing the Basin Plan.

- The Murray Darling Basin Plan is being developed using a range of information but a key report is the SRA 1st report (developed during a major drought). The report concerns include:
  1. used data gathered during a severe drought
  2. employs a reference condition for 'prior to human intervention in the landscape' – which year or period of pre human intervention remains unclear and is open to interpretation. The report itself suggests a level of uncertainty (see above main dot points)
  3. the report acknowledges that the health of an ecosystem cannot readily be judged by comparison
  4. report is an analysis of trends eg 'signs of change' , detected in a period of major drought

The SRA determined river health for 23 River valley catchments. The basis of measurement used the following indicators:

- Hydrology
- Macroinvertebrates condition
- Fish condition

Audit Results:
- One valley (Paroo)- good health
- Two valleys (Border Rivers & Condamine) – moderate health
- Seven valleys – poor health
- Thirteen valleys in very poor health

It is important to note that the river health could be assessed as poor, on two indicators (eg fish & macroinvertebrates) and good health on hydrology – yet the river may still rate poor. An example of this is the Ovens River in Northern Victoria.

This is an unregulated small river with its origins in the Mountains of the Great Victorian Dividing range. Travelling through picturesque mountains and finishing in the Murray River, below the Hume Dam, upstream of Yarrawong, the Ovens River rates as poor because of poor findings on fish and macroinvertebrates, despite hydrology rating high.

The reports key findings note:

Fish: In assessing fish indicators, the presence of alien species (eg carp) could lead to a river health of poor. 'Many upland and Montane zones were rated Poor or Very Poor, and these can contribute significantly to their overall Valley score. These low ratings were often related to the dominance of alien fish in the upper catchments' (SRA)

Macroinvertebrates: 'most valleys show reduced macroinvertebrate diversity relative to their reference condition'.[39]

Hydrology: 'two thirds of the sites were Near Reference Condition for all hydrology indicators'. 'Further improvement is needed to in the hydrological assessment to account for the affects of change in groundwater and vegetation, and of farm dams, and to fully standardise the basis for modelling and analyses across the Basin'. [39]

Policy reversal from Integrated Catchment Management

The MDBA has focused on hydrology and flow volumes as the measure of Murray Darling Basin Health. This is a reversal of significant previous Federal and State Government policy and investments, that recognized total Catchment Management, as an appropriate way, to delivery holistic environmental sustainability.

Using flow volumes as a surrogate for broader river health objectives is contrary to the last decade of Government planning and policy.

CSIRO Sustainable Yield Report

Due to limited time, this report is unable to comment on the CSIRO baseline information at this time. However community concerns do exists with the reliance on models and the error factor that is recognized in most modeled scenario.

Use of Indicator Sites – as a measure of Basin Health

The MDBA has relied on indicator sites to determine environmental water recovery targets to achieve a new level of health for the Basin.

The MDBA has utilized existing information and data. The base of that data cannot always be seen as independent or derived for the purposes of which it is now used.

The MDBA have not provide specific details on how these 'indicator sites' have been assessed, nor has it been established how the sites will be watered or what flow volumes.

There is a strong reliance on existing data that provoke some community concern.

An example of this is the reference to the Millewa Forest in Southern NSW. The MDBA guide references a report that identifies that only 20% of the forest is in healthy condition. This raises community concerns about the reliance on such reports when the full range of other contributing factors remains unknown. Despite being references, efforts to track down this report have not enabled the community to assess the merits of the 'only 20% healthy claim'.[1]

[39] MDBC Ministerial Council; Sustainable Rivers Audit

[1] MDBA Guide to the Proposed Basin Plan

It is worth noting that the Millewa forest received five floods from the period 1990 – 2000. The onset of the Millenium drought 2001-2010, naturally had an impact on some levels of the forest health. However the forest received an environmental watering event in 2004/05 with the provision of its entitlement flows under the Murray & Lower Darling Water Sharing Plan of 512,000 ML.

This is a significant amount of water and together with the previous flooding events, raises the concern about how much water does the forest require if such significant amounts of natural and environmental waterings have occurred, yet the forest rates as only 20% healthy.

In a broader sense, the use of indicator sites as a measure of health is a poor surrogate for a more comprehensive assessment of the Basin environmental status. The Water Act 2007 and therefore the Basin Plan, only addresses flow volumes as the measure of river health. This excludes all other factors and assumes that 'flows = health'.

The MDBA have identified that of the minimum 3000 GL to be recovered for the environment. However 2000 GL of this targeted to flow out to sea as end of system flows over the barrages.

This raises the question in the community, that the key driver for site indicators, appears to be 'end of system' flows, rather than addressing the specific range of needs beyond flow volumes.

There are key concerns that a 'bias' toward desired flows for end of system flows, will create the perception that bulk flows for set durations (as indicated in the plan), will achieve environmental outcomes.

It is not clear how the reliance on large flow volumes will be delivered within river system capacity constraints. There is a presumption that environmental flows can be 'stored' and then delivered in larger volumes on the back of high river or smaller flooding events.

Such a view ignores a more comprehensive assessment other than flow and a perception of desired duration.

In the Wakool River system, there have been two significant environmental disasters in the summer of 2009 when stock and domestic water was released into the Merran and Collingen Creek. The local community had sought smaller more regular flow releases to maintain ecosystem health and such releases would also provide for critical human needs for stock and domestic water supplies. However the releases were not delivered when localized knowledge advised and the resultant 'Blackwater' events occurred, causing major fish deaths.

Blackwater events impact on water quality as carbon is leached from (leaves, twig and bark on the forest floor or floodplain)

Blackwater flows have very low levels of dissolved oxygen and these flows caused significant deaths for Murray Cod, crayfish, aquatic animals and other native/non native fish. Thousands of species perished, including hundreds of Murray Cod, some up to 80 years old.

Significant local community concern had been raised over an extended period that argued strongly for more regular water releases into the system. This did not occur when requested and when flows did arrive in hot weather, the scale of Murray Cod deaths, was of an unacceptable magnitude.

Another blackwater event in October 2010 saw approximately 200 km of the Wakool River a further environmental disaster. The river lies 35km east of Swan Hill and is a well known nursery for Murray Cod.

In both cases the scale of fish deaths and other invertebrates was in the thousands. The age of the Murray Cod that died reinforced what local communities knew – that is – the importance of the Wakool River System as a major breeding ground for the Murray Cod.

Photo: Pastoral Times Newspaper, 2009 Blackwater event Stewart Ellis removing dead Murray Cod – Merran Creek

photo: Wakool River Association Marcus & Graeme Nalder February 09

The MDBA Plan aims to increased flows to the sea through the Murray Mouth, by a minimum of 2000 GL. This focus on end of system flows totally ignores the wider needs of the Basin's environments and reflects the Authority's view that the icon sites, particularly Coorong, Lower Lakes and Murray Mouth, have priority in the Basin Plan.

There is considerable debate by those communities adjacent and familiar with the systems about the scale of water required and the length of flood duration being proposed by the authority.

Absence of environmental water delivery plan

It is difficult to determine whether flow volumes proposed will provide the desired environmental outcomes. Without stakeholder consultation on the delivery of such flows, there is a real risk that mistakes will occur. The fish deaths in the Wakool River system identify the critical nature of local stakeholder knowledge and input into decision making.

The MDBA has failed to adequately address community concerns about the delivery plans for the volumes of water proposed for the environment.

In 2010, the onset of major flood events highlights the cyclical nature of the Basin water resources. There has been a strong belief in the Canberra bureaucracy that 'flood events' would not occur again. This was articulated over many years and prior to 2010, appears to be a widely held belief by many decision makers.

The basis of this belief was modeled predictions for climate change.

It is worth acknowledging that the Basin's history of water planning was built around the natural variations of rainfall and runoff, that have historically occurred in the Basin.

The MDBA has articulated a desire to 'reinstate' flood events and overbank flows. While this may feasible at certain times of the years and in certain locations, there are however a range of factors to consider.

A confidential briefing note obtained under the Freedom of Information laws, 'advises the government it may have to consider compensating farmers for any flooding caused by increased environmental flows' [40]

Communities at risk of flooding have identified potential problems, however have been excluded from providing detailed advice to minimize risk due to the nature of public consultation.

In the absence of an environmental water delivery plan, the community is unable to assess the total impacts, proposed by the plan.

It widely acknowledged that community participation in natural resource planning is essential for long term gains.

In the event of restoring environmental flows, local knowledge and data is critical to ensure that the timing of releases are maximized, the flow volumes are delivered where and when the MDBA has presumed. Utilising local knowledge may ensure that environmental flows are maximized in some areas more quickly, but minimized in others to prevent adverse impacts.

The MDBA will be aware of flow capacity constraints from the major storages such as Hume and Blowering. The floods occurring in the Murrumbidgee and Murray system in 2010 in an unnatural flood period scenario, is worthy of reflection in relation to risk.

In the Murray system during the week of 13th December 2010 to 17th December, considerable rural areas were subject to flood risk as a result of predicted flow heights at Tocumwal. The merging of the Hume releases, Kiewa and Ovens unregulated tributary inflows, combining and causing water releases from Yarrawonga, posed significant high flow and low level flood events. As the predicted heights of the Murray River at Tocumwal were lower than expected, the risk of broader flooding were minimized.

The results of this scenario could have been vastly different, had environmental flow entitlements been released, either preceeding or post such flows.

[40] Australian Newspaper 18.12.2010

An extremely relevant factor was the flow height variations in other associated empheral streams. Add to this, inflows from Victoria from the Goulburn and Campaspe just above Echuca and the flood behaviour would have been varied again.

This highlights the lack of awareness of the MDBA in 'risks' as with no overall environmental water plan delivery analysis – the MDBA's recommendation may pose considerable additional economic and social costs.

In the expenditure of such significant quantities of taxpayers funds, it should be accepted standard of governance to ensure that the flow volumes are determined on need and developed, on the basis, of a well constructed water delivery plan. These parallel events have not occurred in the Guide to the Proposed Basin Plan.

In ensuring that social and economic impacts are minimized, a water delivery plan should be a critical component of planning. Further, while the MDBA have identified no greater than 40% impact to a region by the determination of new SDLs under the proposed plan, without a water delivery plan, it is impossible for the MDBA to make any sense of the impacts.

An environmental water delivery plan is essential to understand potential 3rd party flood risks and/or any potential risks for current water entitlement holders accessing their announced allocations in periods of peak demand.

Social and economic studies – limitations

The MDBA Guide itself and MDBA employees have identified that risks exist, to the 'reliability' of entitlements, particularly when the initial planning phase moves to the delivery phase under State arrangements.

Social and economic analysis commissioned by the MDBA has failed to include any consideration of impact on reliability of entitlements. The MDBA Guide seeks to reduce impacts from the Basin Plan to within or below a 40% impact. However the impact on reliability will not be known until the Basin plan is fully implemented under the relevant State water sharing plans. The determination of impact therefore is subsequent to the social and economic studies and subsequent to the setting of the sustainable diversion limits for each valley.

There has been no assessment of 3rd party flood risks. Flood risks (cost incurred) are not limited to the immediate flood event, but also extend to increased rate charges on landholdings, as Councils seek to recover costs of damaged infrastructure in the event of 'managed environmental flows', moving to an 'unmanaged environmental flood'.

The MDBA objective is to reinstate over bank flows and reinstate flood events. The Guide said it will not cause adverse flood risks. It has not identified to the community how these two scenarios's can be achieved. Particularly assessing the risk associated with piggybacking environmental flows on high river events.

In the event that the MDBA has failed to do ensure a proper and thorough analysis of risk, the MDBA is not in a position to ensure that their 'unacceptable 40% level of impact' can be avoided.

The claims of 800 job losses by the MDBA, as a result of the plan is not worth exploring and perhaps this assessment is a reflection of the wider issues of concern relating to the details of the proposed Basin plan.

South Australian Government - 'Securing the Future – A long term plan for the Coorong Lower Lakes & Murray Mouth (CLLMM)

In June 2010, the South Australian Government released a report 'Securing the Future – a long-term plan for the Coorong, Lower Lakes and Murray Mouth (CLLMM)

This report has been funded by the Federal Department of the Environment, Heritage and the Arts, as part of the South Australian Government's $610 million Murray Futures Program. Funding was part of the Federal Governments – Water for Futures Program

The South Australian Government website refers to the developing and implementation of the long-term plan, funded by the Australian Government's, Water for the Future Program.

There is a strong correlation between the MDBA's - Guide to the Proposed Basin Plan and the South Australian Government and Department of Environment, Water, Heritage and the Arts policy objectives for the CLLMM site.

The Guide to the proposed Basin Plan, sets very clear objectives for end of system flows.

Of the minimum **3000 GL proposed by the MDBA**, to be **recovered for the environment**, a minimum **2000 GL** is targeted to flow over the barrages **through the Murray Mouth**, into the Southern Ocean.

The MDBA identify that long term modeled average flows currently out the Murray Mouth is 5100 Gl/year. The South Australian long term plan for the CLLMM site, note that "average annual outflows through the Murray Mouth are 4,700 GL" [13]. This SA report notes that **at 4,700 GL, the CLLMM ecosystem would probably be in good condition**" [13] but that is "years of below-average flows that cause concern" [13]

The MDBA, as a minimum recommendation, identify end-of-system flows to be increased to 7100 – 7600 GL (ie >2000 GL/y). This would appear consistent with an objective to raise average flows to this high figure, thus in periods of lower flows, the average flow could potentially be 4,700 GL, thus ensuring that the CLLMM site can be maintained under current operating procedures, with limited other actions or investment upgrades required.

This appears as the most striking example of a pre-determine position of the MDBA and reflects the long term planning for the site by a range of interests. In the MDBA 'Guide to the Proposed Basin Plan' and the focus on 'end of system flows' appears entirely consistent with the desired objectives of the South Australian Governments report, Securing the Future – a long term plan for the Coorong, Lower Lakes and Murray Mouth.

This bias towards end of system flows appears consistent with the view expressed by the MDBA's Rob Freeman, that "a system with 80 % outflows' determines a healthy environment.[41]

[13] Government of SA – Securing the Future CLLMM

[41] MDBA – Melbourne Consultation meeting 28.10.2010

The desire for the scale of 'end-of-system flows' is consistent with the Wentworth Groups & Associated names whose 'analysis of options for achieving a sustainable diversion limit in the Murray-Darling Basin', determine that a 'working river' is not healthy unless two thirds of natural flow levels are in place.

The summary section of the SA Plan - 'Securing the Future – a long term plan for the Coorong, Lower Lakes and Murray Mouth', identifies that:

> 'large flows down the Murray River will maintain an open mouth and transport salt and other pollutants to the ocean via natural processes'. [13]
>
> 'When **flows are adequate to maintain the Lower Lakes at or near an optimal operating range**, **minimal intervention is required** and adaptation actions that aim to build and maintain a resilient ecology at the site are possible':[13]
>
> These include:
> - Management of the lakes at variable levels to achieve ecological improvements
> - Enhanced diversions of water from the South-east of South Australia to the South Lagoon of the Coorong (via wetlands and watercourses where possible)
> - Vegetation plantings to restore ecological processes
> - The operation of fishways' [13]

The Plan includes in its objectives:
- Lake Alexandrina & Albert remain predominantly freshwater
- The Murray Mouth is predominantly kept open by end-of-system flows
- There is a return of amenity for local residents and their communities
- Tourism and recreation businesses can utilize the lakes and Coorong
- Productive and profitable primary industries continue [13]

These objectives are consistent with the section stating implications of the regions, in the MDBA Guide to the proposed Basin Plan:

> 'For the SA Murray below lock 1, more reliable water levels in the river and the Lower Lakes as a result of reductions in current diversion limits across the Basin may include a number of important social and economic benefits to the region, including boating, commercial fishing, experiential and eco-tourism, as well as the potential for greater well-being of the community'.[1]
>
> Section 6.5 of 'Securing the Future' (page 80) identifies that drawing from the best available information (CSIRO) it is **reasonable to base the plan for the Lower Lakes around fresh water.** The development of the **Basin Plan is a most significant initiative contributing to an adequate end-of-system freshwater flow'**. 'Given these predictions for fresh water, the option of admitting seawater into the Lower Lakes by permanently opening the barrages is not seen as a necessary, desirable or long term approach'. [13]

[13] Government of SA – Securing the Future CLLMM

[1] MDBA Guide to the Proposed Basin Plan

The MDBA Guide identifies many negatives for other valleys as a result of new SDLs proposed by the Guide to the Basin Plan. South Australia below Lock 1, as noted in the MDBA guide, will be a key beneficiary.

It is of concern that the MDBA and the South Australian report (Securing the Future) has ignored a suite of information including previous recommendations of the Murray Darling Commission – *River Murray Barrages, Environmental Flows 'An evaluation of environmental flow needs in the Lower Lakes and Coorong'* – a report for the Murray Darling Basin Commission – June 200.

Key recommendations from this report that are important but appear not specifically addressed by either the Murray Darling Basin Authority or the South Australian Report Securing the Future for CLLMM include:

- Automate barrage gates for more flexible operations and sensitivity to ecological needs
- Modify Mundoo Barrage to increase flow capacity and operate preferentially to limit sedimentation in the Murray Mouth
- Evaluate options for relocation and revised management of the barrages to enlarge estuarine area to increase the range of habitats[42]

There is also a range of other information that is extremely relevant to the future management of the site – specifically flow issues versus natural coastal actions. Again this information has not been utilized by the MDBA, instead focusing on an 'end of system flow' model, for addressing environmental needs of the broader Coorong, Lower Lakes and Murray Mouth site.

It is note worthy that literature associated with the site, particularly since mid 2000s, is more closely aligned with a view to increasing flows from the Murray River via end of system flows, as a solution for sedimentation (sand) build up at the Murray Mouth.

The Coorong, Lower Lakes & Murray Mouth - Ramsar site (full report: attachment A)

Overview:
The Sustainable Rivers Audit 'framework' established by the Murray Darling Basin Ministerial Council, stated that 'this river zone, being at the downstream end, is under the greatest hydrological stress of any in the River Murray System'.[43]

In reviewing this statement, it is prudent to explore historical influences of the region.

The Australian Federal Government listed the Lower Lakes, Murray Mouth and Coorong as a wetland of significance under Ramsar in 1985. A Ramsar listed site does not reflect a 'pristine' or necessarily, a natural environment. A site can be significantly altered from an original state and still achieve Ramsar listing (eg Coorong, Lower Lakes)

In line with Ramsar protocols, once a Ramsar site is listed, a plan of management is developed, which includes an ecological character description, which enables future monitoring to be measured. The hyper saline conditions of the Southern Lagoon was specifically noted as part of the character description of the Coorong.

[42] MDBC – River Murray Barrages, Environmental Flow Report
[43] MDBC – Living Murray Foundation Report

From the time of the site's original listing in 1985, it was not until 2000 that the actual plan of management was developed, with the subsequent more detailed 'ecological character descriptions', completed in 2005.

Lower Lakes:
The Lower Lakes system holds approximately 1900 GL of water. Alexandrina (1570 GL) Albert (280 GL) and tributaries of Currency Creek and Finniss River (50 GL)

Lake Alexandrina the largest of the two lakes covers an area of approximately 76,000 ha and is generally no more than 4m in depth. Lake Albert is approximately 16,500 ha and generally much shallower. On average the Lakes **evaporate approximately 750,000 ML to 900,000 ML per year**

Prior to the construction of five concrete barrages in late 1930s-1940 (distance 7.6 km), the natural tidal ecosystem of the Lower Lakes comprised, merged freshwater flows from the Murray and tidal inflows from the Southern ocean. The construction of the five barrages removed 90% of the natural tidal prism that historically influenced the estuarine environment.[44] The flows from the lakes through the barrages to the Murray Mouth, have been operated by 593 independent and manually operated gates.

The Barrages artificially raise the Lake levels and lower Murray River levels up to Lock 1 (274 km upstream) at 0.75m higher than mean sea level (AHD) (Living Murray foundation report)

When Murray River flows are limited to South Australian entitlements flows in summer, evaporation rates (part of the noted evaporation rates of 750,000 – 950,000 ML/yr) may exceed inflows and therefore the Lower Lakes were levels will drop.

To avoid this, Lake Levels are surcharged by 100mm to 0.85m AHD at the beginning of summer. **Barrages are closed and by autumn**, evaporation rates generally drop the Lakes back to an operating level of 0.6 AHD. This is the level where 'gravity' fed irrigation can occur without requiring pumping, in the Lower section of the Murray River ie between Lock 1 and the lakes.

When seasonable conditions are favourable and additional water above South Australia's entitlement flow can occur, the Lakes can be managed at more varying levels. [43]

Securing the Future, A Long Term Plan for the Coorong, Lower Lakes and Murray Mouth (June 2010), claims that "before water resource development, severe drought inflows to the Lower Lakes never occurred. Under these conditions, the minimum annual inflow to the Lower Lakes were 2,250 GL". [13]

This appears contradictory to photographic and historical references which identify that the Murray River itself, including in South Australia, has dried to a series of salty pools during major drought periods. Therefore, it may be assumed that the referred, 'minimum annual inflows to the Lower Lakes of 2,250 GL', must have been localised inflows derived with the Lakes region itself.

[44] Bourman R & Barnett E – Impacts of River Regulation on the Terminate Lakes & the Mouth of the River Murray
[43] MDBC Living Murray Foundation Report
[13] Government of SA – Securing the Future CLLMM

Prior to building of the barrages to convert the estuary into permanent freshwater lakes, 70% of the historical flows from the Murray River would move through the Goolwa channel (released now controlled by the Goolwa barrage). 10% of flows would flow through the Mundoo Channel and the remained through the Tauwitchere, Boundary Creek and Ewe Island (Oliver and Anderson 1940) [11]

The construction of the barrages has negatively impacted on the natural estuarine interactions with the Southern Ocean. The initial barrage built over the Mundoo channel limiting sea water inflows in 1915 (Johnston 1917) created the first artificial barrier to sea water entering the Lower Lakes. The subsequent five permanent barrages completed in 1940 reduced the river flows to the sea and changed the natural tidal prism by 90%.

Historically, during periods of low flows in the Murray River, the Murray Mouth was kept open by natural tidal flushing. [11]

Coorong:
The Coorong and Murray Mouth areas is outside the Lakes system created by the concrete barrages and this section makes up 11% of original estuarine area that still remains. The volumes of this area are now largely determined by the seasonal events (eg local rainfall), marine waters from the Southern Ocean and barrages operations, that release fresh water flows, from the Muray River and localised tributaries.

The Northern Lagoon of the Coorong is largely influenced by tidal events, through the Murray Mouth and Murray River freshwater flows releases, via the concrete barrages.

The Southern Lagoon of the Coorong was naturally supplied with fresh water flows from the natural drainage patterns of South East of South Australia.

The South East region of South Australia has no natural drainage that would discharge large volumes of floodwaters to an ocean outfall. Some waters did gravitate to the Southern Ocean, primarily through the Glenelg River and localised springs.[45]

The landscape's geological formation, resulted in natural drainage patterns ending in wetlands, swamps and marshland. This complex series of wetlands would eventually drain north westerly, with much of the overland and sub surface flows flowing into the southern lagoon of the Coorong.

The ecology of the Southern Lagoon of the Coorong has evolved from these natural drainage flows, wetlands and marshlands. The Southern lagoon is a land locked system, almost separated from the northern part of the Southern lagoon by a narrow land formation near Parnka Point. Here the two lagoons are linked by a relatively shallow narrow channel.

Marine influence in the Southern Lagoon from the Southern Ocean has been minimal. The Department of Water, Land and Biodiversity (DWL&BC) as part of the water quality assessment under Upper South East Drainage (USE) Program, commissioned a report titled - A Palaeoecological Assessment of Water Quality Change in the Coorong (Gell P).

Using diatom analysis and dating techniques the study determine the timelines for changing water quality conditions for the Coorong Lagoons. [46]

[11] Bourman R; Rapid coastal geomorphic change in the River Murray Estuary
[45] DWLBC report 2006/25

The report's executive summary stated:

> 'Before European settlement the northern lagoon of the Coorong was dominated by tidal input of marine water. Marine flushing also strongly influenced the southern lagoon but less frequently or to a lesser extent. At no time in the 300 years before European settlement has the Coorong been noticeably influenced by flows from the Murray River.' [46]

There have been two major land drainage and reclamation schemes that have impacted on the ecological condition of the Coorong.

The construction of the South East Drainage Scheme in South East of South Australia drained this naturally wet landscape. Over a period from 1863 through to 1975, wetlands, swamps and natural drainage lines were 'reclaimed' for human passage and agriculture. [47]

A subsequent drainage scheme was initiated in 1993 and approved in 1996. This Upper South East Drainage and Flood Mitigation Scheme was developed in response to growing concerns about modelled prediction on salinity risks to the region and for flood mitigation. Funded under the Natural Heritage Trust, addressing salinity risks and managing flood waters, saw the natural water flows of the Upper South East area further amend the natural drainage flows of localised swamps and marshes. This stage drainage scheme together with the main South East Drainage Scheme, added to the changed drainage patterns, for the whole South East region.

The original lower South East Drainage scheme and the more recent Upper South Drainage Flood Mitigation Scheme, together continue to impact on the ecology of the Coorong.

When the Coorong was listed as a Ramsar site in 1985, there was a specific reference to the 'hyper saline conditions of the Southern Lagoon'. The Coorong and Lake Alexandrina and Albert Management Plan note in (section 5.6):

> "to conserve the ecological character of the southern lagoon as a mostly hypersaline lagoon, manage the timing and volumes of discharge under the Upper South East Dryland Salinity and Flood Management Plan (USEDS & FMPs) into the Southern Coorong, is based on the approved discharge of 40,000 Megalitres/year as the mean of a rolling ten-year average with most discharge through winter and early spring"

Note: The Commonwealth of Australia has imposed, as a condition of its approval and financial support for the Upper South East Dryland Salinity and Flood Management Plan, a maximum discharge of 40,000 megalites/year on ten-year rolling average is permitted into the Southern Coorong. (note: this is to maintain the hyper saline state – an ecological character criteria at the time the site was listed under RAMSAR)

In determining the environmental needs of the Coorong, Australians may be rightly confused.

On the one hand the ecological decline of the Coorong is blamed on river extractions within the States of NSW, Victoria and Queensland. However, on closer examination, the

[46] Gell P – A Palaeoecological Assessment of Water Quality change in the Coorong

[47] SRI – Advice to the MDBA Lower Lakes Coorong

significant ecological changes that have occurred to the Coorong, have largely resulted from historical planning to drain and reclaim land for agriculture in the South East of South Australia from 1863 – 1975. Further major investments in drainage schemes occurred more recently as part of the salinity and flood mitigation strategy funded by the Australian Government Natural Heritage Trust Program.

Major changes to the natural flow patterns of the South East of South Australia have drained freshwater flows away from the Coorong directly out to the Southern Ocean, or alternatively, limited freshwater inflows (ie from the USEDS & FMPs) as rule to maintain the hyper saline state of the Southern Lagoon.

An example of flow volumes re-directed away from the Coorong out to sea, by the (Lower) South East Drainage schemes include:

> "The combined average annual discharge to the sea from the Blackford Drain, drain L and drain M = 136.4 GL. Discharge is variable and in high rainfall years very large volumes flow to the sea through these drains"[13]
>
> For example in 2000 the combined total discharge was 449.9 GL. Without the drainage network in place, a considerable proportion of this water would have flowed into the Coorong's Southern Lagoon. To put these volumes in context, "the total volume of the South Lagoon varies from approximately 140 GL when full in winter, to 90 GL in late summer". [13]

Murray Mouth

Lake Alexandrina and Lake Albert formed part of an open estuarine system 7000 – 6000 BP (before present). (Walker D.J.) As sea levels rose subsequent to that period (6000-1940 approx), the sand barriers of the Sir Richard and Younghusband Peninsulas, were formed and 'enclosed the lower lakes' (Walker D.J.)

The Murray Mouth movement in line with Southern Ocean influences, migration is recorded over 1.6km since the 1830s and up to 6km over the past 3000 years.[43] Migration of 1.4 km has been recorded in the last 160 years. [11]

The Murray estuary is geomorphologically dynamic (Bourman 2000) and movements of 14m over 12 hours, have been recorded.[43]

The Murray Mouth for thousands of years has represented the end most connection between the estuarine areas of the Lower Lakes, the Coorong, the islands and tidal regions that now form the coastal zone bounded by the Sir Richard Peninsula and the Younghusband Peninsula.

The Murray Mouth itself has undergone significant changes through the construction and operations of the barrages and river regulation.

> "based on observations at the time it was suggested that flows of 25,000 to 30,000 ML/day were required to maintain and expand the artificial opening. This then led

[13] Government of South Australia – Securing the Future CLLMM
[11] Bourman R; Murray-Wallace C; Belperio A; Harvey N – Rapid Coastal Geomorphic change in the River Murray Estuary of Australia
[43] Living Murray Foundation Report

> to the estimate **that 20,000 ML/day for four weeks** should restore a **severely restricted mouth** to a healthy state. **This figure has been quoted ever since** (Harvey, 1988, Bourman and Barrett 1995). [49]

Early studies in 1914 identify that, prior to the construction of the barrages, the tidal prism influencing the estuary and the Murray Mouth was estimated to be 16,900 ML. At this time, the area of the Lower Lakes affected by the tidal prism was 97.3 km2 (Johnston, 1917). Following the construction of the current barrages in 1940, 90% of the tidal prism has now been removed. [11]

A further calculation of the pre barrage tidal "spring" prism was done by Walker (1990), who estimated that the tidal prism was approximately 20,000 ML.

A more recent estimate of the **current** tidal prism show a tidal influence in the range of **643 and 2,200 (**Murray Mouth Advisory Committee 1987).

It is a common misconception today, that traditional Murray River flows were of the vicinity of 20,000 ML and this may be viewed as the required amount of mouth outflows to ensure continually scouring of sand deposited by incoming tides.

This perception ignored the historical flows out the Murray Mouth that would have consisted of fresh water flows from the Murray River and tidal influences from the Southern Ocean.

In 2002, a report was done by D. J. Walker, Centre for Applied Modelling in Water Engineering, Department of Civil & Environmental Engineering, Adelaide University - The Behaviour and Future of the River Murray Mouth.

The models map a ten year period 1990 -2000 and compare modelled predictions on a natural flow and a regulated flow.

> 'figure 2.3, identifies predicted flows at the Murray Mouth under natural and regulated conditions for a ten year period. The flow predictions, supplies by MDBC, were based on a computer simulation that uses known river flows at a lock some distance from the Mouth and takes into account water extractions, losses due to seepage and evaporation, barrages operation and lower lake levels. These predictions are necessary because the actual flow over the barrages is not measured.' (Walker D.J.)

> 'the changes at the Mouth have been linked to the construction of the barrages and a possible course of action would be to remove the barrages and return the Mouth to 'its natural state'. Havey (1996) quotes estimates to tidal prism that indicated the construction of the barrages reduced the flow by around 90%. This would have a significant effect on the size of the Mouth under normal conditions. The micro-tidal wave dominated coastal environment means that the River Murray Mouth is likely to have excessive sedimentation inside the Mouth area and in the past the tendency to close would have been balanced by the consistent pattern of river flows flushing sediment from the Mouth'.

[49] Walker D – the Behaviour and Future of the River Murray Mouth

[11] Bourman R, Murray-Wallace C; Belperio A; Harvey N – Rapid Coastal Geomorphic change in the River Murray Estuary of Australia

> ‘The report uses ‘data collected while the barrages were in place it was not possible to use it model the effect of removing the barrages’. ‘

River flows are necessary and integral part to ‘the long-term maintenance of the current Murray Mouth, but it is evident that during periods of **low river discharge**, the **mouth has** been maintained by **wave action and tidal flushing’.**[11]

The Murray Mouth represents a tidal inlet, restricted by the sand barriers of Sir Richard and Younghusband Peninsulas. Narrow inlets can restrict flows which creates a higher gradient ‘flood tide’. (Bourman & Harvey) As the flood tide pushes through the inlet, it scours and deposits sedimentation inside the inlet which creates ‘tidal deltaic deposits’ As the tide goes out, the situation is reversed as the hydrologic gradient pushes sedimentation back towards the ocean. [50]

Tidal fluxes are strongly related to the tidal prism, ie volumes of water that enters and exits the delta during one tidal cycle.[51]

Murray Mouth restriction can be attributed to a range of factors throughout its history. Described in early periods as ‘sand shoals’, Johnston 1917 noted such sedimentation events in the Mouth 1839, 1857, 1876 and 1914. A photograph in 1938 identified ‘plumes of deltaic sandy sediments’ in the Murray Mouth. [50]

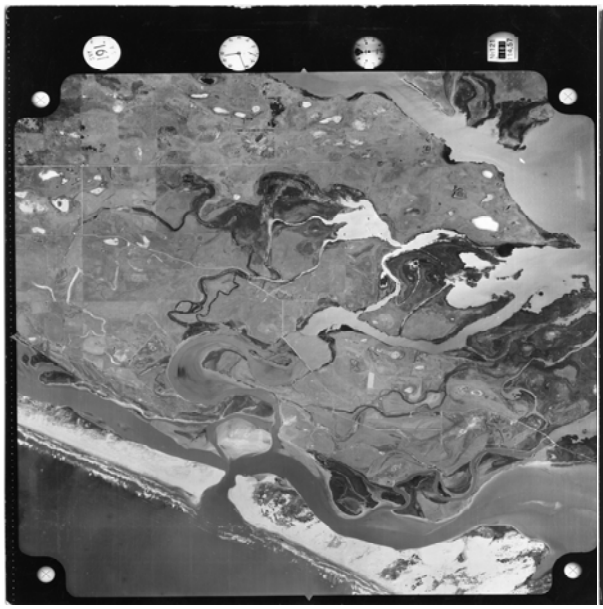
The Murray Mouth nearly closed during the drought periods of 1914, 1967 and 1973. The explorer Sturt noted in his journals in 1836, that it was impossible to navigate safe passage through the sand shoals of the estuary to the sea.

Studies indicate that the construction of the barrages in 1940, ‘reduced the median annual flow to the estuary by 75% and reduced the tidal prism by up to 90% and facilitated the development of Bird Island. The continual development of Bird Island suggests considerable potential for more blockages in the future.’[52]

The Murray Mouth is influenced by ‘fluvial, wave, tidal and aeolian processes’ (Bourman & Harvey).[50]

During the 1956 high flow and flood period, 326,000 ML/day, the mouth was ‘significantly widened’ which scoured the ‘deltaic sediments’.[50]

[11] Bourman R; Murray-Wallace C; Belperio A; Harvey N; Rapid coastal geomorphic change in the River Murray Estuary of Australia
[50] Bourman R; Harvey N – the Murray Mouth Flood Tidal Delta
[51] Fagherazzi S – Self-organisation of tidal deltas
[52] James Kristine – The bio-geomorphological evolution of a former flood tidal delta (Bird Island) in the Murray Mouth Estuary of SA



Murray Mouth – January 1956

Murray Mouth – November 1973 (flood)

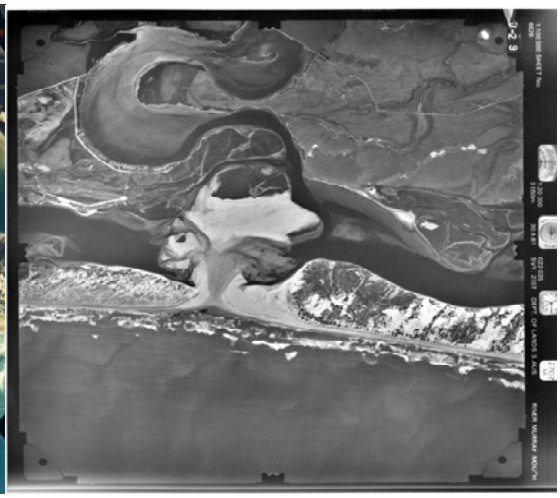
Murray Mouth – February 1988

Murray Mouth – March 1949 (SA mapland)

Murray Mouth – 1966 (SA mapland)

(note: 1949 flood tidal delta – 90 days of no river flow: Bourman;Barnett)

Murray Mouth – March 1995



Murray Mouth - April 1981

Muray Mouth – January 2001

Murray Mouth – March 2003

Following the construction of the barrages in 1940, the Murray River has ceased to flow in dry periods, for '100 or more consecutive days'. These low flow events enabled increased sedimentation within the tidal delta of the Mouth. [50]

Photographs on the 24th April 1945 (5 yrs after construction of the barrages), show increased sedimentation and the formation of a tidal delta following 250 days of no flows (Bourman & Harvey). This event reoccurred after 90 days of no flow and was captured by a photograph on 23rd March 1949.

The risk of the sand deposition or 'shoaling' was first predicted, prior to building the original Mundoo Barrage in 1915 (Moncrieff 1903). Today, the continued growth and stabilisation of Bird Island, has been progressive since the more construction of the permanent Mundoo barrage, built in 1940. The inefficient and archaic operating features of the Mundoo barrage, meaning that rapid reaction to the climatic conditions is not possible. This prevents the ability to mimic natural tidal actions through barrage releases, to assist scouring action at the Murray Mouth.

The continued growth of Bird Island is of concern and will further impact on channel flows in the vicinity of the Tauwitchere Barrage impacting on tidal flows to the Coorong. [50]

Bird Island in 1960 had 'increased in size' and the stability of Bird Island allowed vegetation growth to occur. At this time Murray River flows were 63,000 ML/day. [50]

[50] Bourman R; Harvey N – the Murray Mouth Flood Tidal Delta

Sedimentation of the Mouth estuary was evident in 1966 following 181 days of the barrages being closed (Bourman & Harvey). This build up of sedimentation occurred again in the 1967-68 drought when the barrages were shut for 529 days (Bourman & Harvey). A storm event in 1968 reopened the mouth and scoured the build up of sedimentation. [50]

The Murray Mouth's tidal has two main factors affecting its function, river flows and the coastal climate. Coastal climate factors are tides, wave energy and littoral transport (Walker D.J.)

Walker report states

> 'given the micro-tidal conditions and the domination of wave energy on the coast the large flood tidal delta is to be expected (Hayes, 1991, Harvey 1996). The tendency for inlets of this type to close periodically has been observed in many seasonally open inlets both in Australia and around the World. (Australian Parliament Senate Standing Committee 1981;Bally, 1987;Ranasinghe and Pattiaratchi, 1999)"

Perhaps the most recognised and misunderstood mouth closure was on 30th April 1981, when the Murray Mouth was completely closed off from the Southern Ocean by a build up of sedimentation deposited by incoming tides (20,000 tonnes). At this time the barrages were shut for a period of 196 days. [50]

The photo of Murray Mouth closure in April 1981 (at low tide), has become the iconic symbol of declining river health and over extraction of water in the Murray Darling Basin.

(photo: April 1981. source Websites: Living Murray)

Post the Murray Mouth's closure in April 1981, dredging re opened the passage to the sea in July 1981, with subsequent winter flows maintaining the opening.

<u>The April 1981 photograph of the Murray Mouth closure has ever since been portrayed as a symptom of 'over allocation' of water in the Murray River system for the purposes of irrigation.</u>

[50] Bourman R; Harvey N – the Murray Mouth Flood Tidal Delta
49 Walker D J; The Behaviour and future of the River Murray Mouth

During the Australian Parliament Senate Standing Committee 1981, Culver was quoted 'that in addition to low flows, calm seas and reduced tides appear necessary for a complete closure (mouth)'. (Walker D. J.)[49]

The image itself however, should be viewed in conjunction with the historic photographic references. Photographic images of the Murray Mouth since 1945, identify the continual actions of a tidal delta system with the mouth estuary which have caused severely restricted flows through to the Southern Ocean.

Regular sedimentation of the Murray Mouth estuary has a range of contributing factors, including river regulation, tidal flows, the location and operation of the barrages and the natural tidal and coastal conditions of the Southern Ocean.

The April 1981 physical closure of the Murray Mouth, can be attributed to the 'lack of fluvial action, unusually calm sea conditions, and a period of low high tides'.[50]

The Southern Ocean experienced a particularly calm period between August 1980 and May 1981. According to Bourman & Harvey, a high tide event of 1.8 m on 6th May 1981 re-opened the mouth but it closed again 14th May.

The Living Murray's Foundation report note that the when the blockage of the Murray Mouth occurred in 1981, there was also a build up of the Bird Island flood delta over the previous months.[43]

This report acknowledges the future risks of Bird Island continued growth in size due to increased sedimentation.

The growth of Bird Island has been progressively noted since the 'Mundoo Channel was closed in 1915 by an original barrage with timber sluiceway'[43]

The micro tidal delta of the Murray Mouth operates in a similiar function to other tidal 'deltaic' forms on the Coast of Victoria and New South Wales. [50]

Victoria: Mallacoota (Web; Near Maps)

South Australia: Lower Lakes, Murray Mouth (web; RiverMurray.com)

The Shoalhaven River in New South Wales (NSW) has a similar tidal feature where incoming coastal tides deposit sand at the mouth of the river. The next high river event re-creates the scouring action and re-opens the system to the sea. Freshwater River flows at

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[50] Bourman R; Harvey N – the Murray Mouth Flood Tidal Delta
43 Living Murray Foundation Report

Mallacoota in Victoria, is also reflective of a tidal inlet system. Dominated by sand deposition, with coastal conditions and river flows, influencing the sand bar formations.

> 'The Murray Mouth appears to be a classic landform example from a micro-tidal environment on a high energy coastline. The barrages, a short distance upstream from the delta, not only artificially restrict or cut off river flow, but also reduce the magnitude of the tidal prism. In addition the southeast drainage modifications have reduced freshwater inputs into the Coorong. The consequences of the altered regime at the Murray Mouth has been the progressive stabilization of the formerly ephemeral flood tidal delta' [50]

Periods of Murray Mouth sedimentation have occurred during periods of low flows, drought or even within normal flow years. The normal management operations and flow releases of the barrages, also influence the behaviour the Murray Mouth.

Normal operations of the lakes are managed to maintain water levels at 0.75 AHD. As higher spring flows from the Murray River enter the lakes, lake levels are surcharged (increased) to an operating level of 0.8 AHD. This enables a drawdown of water for irrigation during the warmer months and ensures that evaporation rates between 700,00 to 940,000 ML/year, do not reduce lake levels for most periods below 0.75 AHD.

The restricted releases from the barrages at certain times of season in order to maintain lake levels at 0.75 AHD, contributes to reduced scouring action of the Murray Mouth.

Operation of the barrages has led to significant alteration to the hydrology of the Lower Lakes and Murray Mouth area, and of course, flows are affected by all the regulating structures upstream (Living Murray foundation report)

Yet in determining the needs of this Ramsar listed environment, historical changes that have significantly impacted on the site are not discussed/noted in the relevant literature. The Murray Darling Basin Authority (MDBA) specifically targets hydrological flows from the Murray River to meet environmental challenges for the region. The MDBA set target objectives for increased over barrages flows from 5100 –7700.

This proposed increased flows, should not be the sole solution to remedy environmental challenges to the site. Further investigation is required in relation to:

- Improved understanding of Murray River fresh water flows and their scale of influence being limited to the mid to Northern section of the Northern Lagoon.
- The lack of influence of Murray River flows on the hypersaline conditions of the Southern lagoon of the Coorong.
- An assessment of freshwater flows redirected to the Southern Ocean from the South East of South Australia drainage schemes and the limitations placed on the inflows to the Southern lagoon from the Upper South East Salinity and Flood Management scheme.
- The construction, operation and current management regimes of 5 barrages and this impact on the historical tidal interaction in the estuarine system of the Lower Lakes, that have lead to significant ecological changes.
- The impact of the barrages on increased sedimentation of the Murray Mouth

[50] Bourman R; Harvey N – the Murray Mouth Flood Tidal Delta

Note: the MDBA received a report in April 2010 – Advice to the Murray Darling Basin Authority – Lower Lakes, Coorong (L Burge, SRI NSW)

Conclusion:
the Lower Lakes, Coorong and Murray Mouth site have undergone significant change due to human intervention in the landscape and river regulation (locks/weirs/barrages). Environmental issues, require a comprehensive approach, where the solution does not lie with a simplistic approach of increasing 'end-of-system flows'.

Photographic evidence in 1945, identifies that significant sand accumulation at the Murray Mouth (deposited by incoming Southern Ocean tides) was noted five years after constructions of the barrages. The continued growth of Bird Island continues to pose a risk – this cannot be resolved by 'end-of-system flows'.

Historically, tidal action has been instrumental in maintaining the openness of the Murray Mouth during periods of low Murray River flows. There have been periods up to 529 days of no flows from the Murray, when tidal scouring and storm surges would keep the mouth to the Southern ocean open.[44]

The iconic photograph of the Murray Mouth closure of 1981, a symbol of poor river management, had a number of influencing factors that have been ignored. Prior to this event was a period of unusually calm seas and a lack of storm surges. This was combined with a period of no flows of the river for 196 days. Such low flows had occurred previously, with no mouth closure resulting.

The MDBA should adopt a more comprehensive approach to addressing the range of contributing factors to the decline in environmental conditions in the Lower Lakes, Coorong and Murray Mouth during low flow periods. In particular, identifying investment for operational efficiencies for the barrages and localised solutions, to address environmental issues of the Coorong.

In period of extreme drought, an adaptive management approach to the Lower Lakes and Murray Mouth is required to address low inflow periods.

Salinity

The World Health Authority's (WHO) raw drinking water standard is 800 EC.

Salinity levels in the Murray River since the spike of 1982, have progressively fallen and remain well within the World Health Organisation's raw drinking water standard of 800 EC.

Salinity is a natural component of the Murray Darling Basin soils reflecting its ancient marine history. With marine waters covering extensive areas of what is now known as the Murray Darling Basin, the movement of natural salts in the landscape can be attributed to a range of causes.

[44] Bourman R; Barnett E – Impacts of River Regulation on the Terminal Lakes & Mouth of the River Murray

When the explorer Sturt, first sighed the Murray River in 1820, it was a series of salty pools.

During periods of lower flow, sea water would regularly influence the lower Murray River inland, up to 250 km. (MDBC 2002)

In the 1914 drought, salinity readings in the Murray River at Morgan contained 804 p.p.m of salt. [14]

The Murray River at Murray Bridge which is approximately 110 km upstream from the river mouth, the readings were 6,929 p.p.m. Studies at the time concluded that "this salt appears to have largely originated directly from the sea." [14]

In 1940, five concrete barrages (7.6 km length) were completed, which converted the estuarine areas of Lake Alexandrina and Lake Albert into permanent freshwater water bodies. The 1945 drought, 'when no fresh water passed over the barrages for 12 months, corresponding salt contents were 782 p.p.m (Morgan) and 833 p.p.m. (Murray Bridge)respectively. [14]

Historically the Murray and Darling River salinity readings have varied with climatic conditions, but growing concern on modeled risks for salinity led to the 1987 Salinity Drainage strategy. This sought to ensure that the Murray River's water quality target was to retain salinity readings at the official Morgan site (in SA) at or below 800 EC.

Salinity had became a major environmental policy issue in the mid 1990's, following wetter than average years in the 1990s. There were two major reports that contributed to political elevation of salinity. The Salinity Audit of the Murray Darling-Basin (Murray Darling Ministerial Council 1999) and the Prime Minister's Science, Engineering and Innovation Council (1999). [53]

The National Salinity Audit 2000, was identified to be "Australia's most comprehensive national assessment of dryland salinity". However this report itself, refers to the term 'best available science'.

The National Salinity Audit predicted that 5.7 million hectares were considered currently at risk of dryland salinity. The report predicted that by 2050, 17 million hectares of land would be subject to risks of salinity, mainly in Western Australia.

Prior to 2003, the CSIRO Land and Water Website stated:

> "the Murray-Darling Basin, shows the nature of the problem we face. Salt levels are rising in almost all the Basin's rivers and now exceed WHO guidelines for drinking water in many areas. Business as usual is not an option. If we do nothing, the salinity of the Lower River Murray – where Adelaide pumps outs its drinking water – will eventually rise to exceed WHO guidelines". [54]

Salinity predictions led to the National Action Plan for Salinity and Water Quality and a $1.4 billion investment from the Natural Heritage Trust, over seven years (to 2008) to address the risks.

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[14] de L'Association Internationale des Sciences – Sea Water Exclusion from Australia's River Murray

[53] Pannell D – Politics and dryland salinity; history, tensions and prospects

[54] Marohasy J – Myth and the Murray (IPA)

The National Action Plan website refers to "the area of salt affected land in Western Australia is increasing at a rate of **one football field per hour**" and "if salinity is not effectively managed within 20 years, the salt content in Adelaide's drinking water may exceed World Health Organisation standards for desirable drinking water in two of every five days". [10]

Salinity is the term to describe the salt content of soil or water. The National Action Plan refers to 'salinity increases are usually caused by a rise in the level of underground water-tables bringing naturally occurring salt to the surface" (NAP)

In **South Australia**, estimates of areas affected by dryland salinity went from **55,000 in 1982** to **393,000 ha in 1993** [55]

In the National **Land and Water Resources Audit – *Extent and impacts of dryland salinity in South Australia*** (SA) (December 2000), agricultural land estimated to be affected by dryland salinity, was 421,000 ha in 2020 and 521,000 in 2050. [55]

Initial predictions, of rising groundwater and corresponding salinity risks, led to major Federal and State Government investment in addressing the risks. In SA, this included the Upper South East Drainage and Flood Mitigation Plan.

As in other parts of the Basin, the incidence of salinity risk associated with wetter periods, occured in areas where there is a strong correlation between the permeability of local aquifer, higher rainfall events and localized rising groundwater. The wetter events during the 1990's in many parts of the Basin, particularly 1992/1993 in South Australia, contributed to the heightened concerns about salinity risks. [55]

In referring to the extent and trends of dryland salinity, the audit identified "the dramatic increase in areas affected by dryland salinity in some regions is most likely the result of increased awareness and better recognition of the problem, rather than the physical expansion of salinisation (however in some areas, salinisation has increased significantly, especially after very wet years)".[55]

The report in South Australia stated though, that these estimates in conjunction with estimated costs of dryland salinity even in 2050, would be less than 1% of South Australia's agricultural production. The report indicates that dryland salinity is of "less significance in South Australia than some other mainland states". [55]

The audit referred to groundwater modeling in the Mallee region that predicted a rise in salinity of 118EC by 2050, costing consumers $17.4M/year (extent.) The rise in groundwater and associated risks to land salinisation was estimated as a result of vegetation clearance in the Mallee. However, differences of views exist about the predicted impacts of groundwater modeling and associated salinity risks. Reliable information on the risks of the Mallee salt movement, is difficult to obtain. Currently there is still a reliance on the MDBC earlier position.

[10] AFG; National Action Plan for Salinity & Water Quality

[55] National Land and Water Resources Audit – Extent & Impact of dryland salinity in SA

In Myth and the Murray, Marohasy refers to the MDBC Basin Salinity Management Strategy 2001-2015 and the claims that the 'Mallee region, represents the greatest potential risk in terms of salt contribution to Morgan'.

Marohasy paper refers to the CSIRO technical paper, Groundwater Recharge in the Mallee Region, and salinity implications for the Murray River – A Review.

Findings in this technical paper include:

> "….the time for the increase in deep drainage to reach the water table is related to the deep drainage rate, the initial watertable depth, and the soil water content within the unsaturated zone. Throughout most of the (Mallee) area, water tables are more than 20m below the land surface, and this time delay is of the order of tens of years'. Because much of the Mallee region was cleared between 50 and 100 years ago, watertables should now be rising over much of the region'. The report also notes that trends could not be determined due to the 'scarcity of data.[54]

As was noted in many other parts of the Basin, the National Land and Water Resources Audit – Extent and impacts of dryland salinity in South Australia, identified similar observations:

> "because most of the groundwater trends are strongly controlled by rainfall, watertable levels have been falling throughout SA for the last 2-3 years up until the year 2000, due to well below average winter rainfall. Some drier catchments have experienced falling groundwater levels since 1993.

The Audit identified;

> "that a continually rising groundwater trend is only evident in the 'regional flows systems of the Murray Darling" and "future groundwater trends will depend on future rainfall patterns which are notoriously difficult to predict. The greenhouse effect is expected to lead to lower winter and higher summer rainfalls, however the degree to which other cyclical patterns (eg the eleven year solar cycle) will impact on these trends is unknown" [55]

Subsequent to the period surrounding the peak of the 'salinity crisis', affecting many parts of the Murray Darling Basin, concerns were raised about the accuracy of the original modeled predictions.

The Australian Farm Institute "… Individual research says the figure doesn't look right because the model that underlay it – basically - isn't what's happening in practice".[56]

In 2005, Professor Wayne Meyer, chief scientists at the CRC for Irrigation Futures in ABC Science …. 'there's no question that salinity fears have been exaggerated in some parts of Australia… this could be a short-term effect caused by environmental factors,… but adds 'now is a good time to revisit the 2000 figures'. 'We're five years down the track so it's probably time to have another look at that information … and it may well change'. [56]

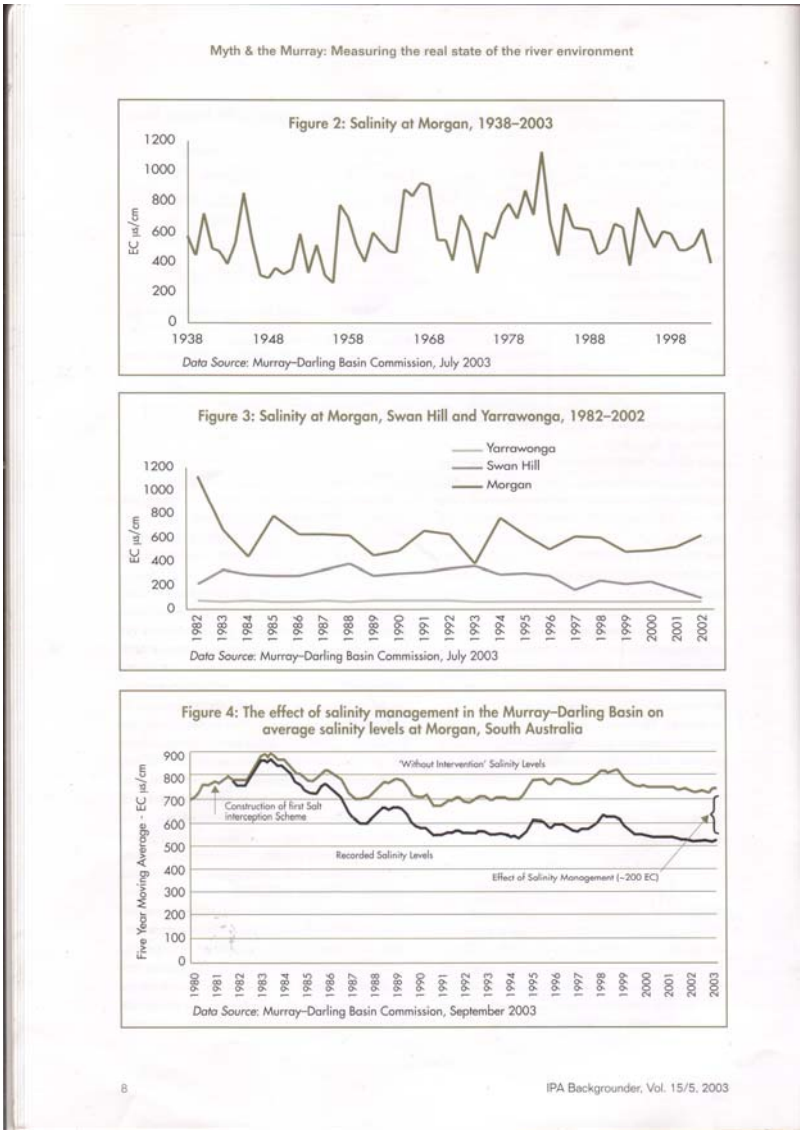
[54] Marohasy J – Myth & the Murray

[55] National Land and Water Resources Audit – Extent & Impact of dryland salinity in SA

[56] ABC Science: www.abc.net.au/science/articles/2005

In the report, Myth and the Murray – Measuring the Real State of the River Environment: Jennifer Marohasy (IPA 2003), noted that a 'plot of average salinity levels for the last 20 years indicate that salinity levels have dropped since the drought of 1982".

The Myth and the Murray report notes the MDBC's agreement with these findings and the MDBC comments …...'average salinity in the River Murray has in effect improved during the last decade'. [54]



Salinity will require continued monitoring, however assumption on rising groundwater which influenced higher modeled predictions of risk, proved incompatible with practical observation. While salinity management remains an issue in specific parts of Australia, a more cautious and comprehensive approach now seems to prevail.

A report published by the Murray Darling Basin Commission in 2003 – Modelling the Effectiveness of Recharge Reduction for Salinity Management - Sensitivity to Catchment Characteristics, notes that 'large parts of Australia have a lack of detailed hydrolgeological data on which to base future predictions of changes in land and river salinity'.

There has been significant investment in addressing salinity risks in many areas. Salt interception works at strategic locations adjacent to the Murray River, have contributed to water quality objectives.

The MDBC have determined that "on a five year rolling average, by modeling the situation without salt interceptions, the MDBC has calculated that salinity has dropped by approximately 200 EC units as a consequence of the salt-interception schemes".

Salinity issues for the lower reaches of the River Murray, Lower Lakes and Coorong are varied and have a range of influencing factors.

The ecosystem function of the region has been substantially altered since the construction of the barrages which changed the dynamics of the Lower Lakes and the natural interaction with the Southern Ocean and the lower reaches of the Murray River.

The Murray between Lock 1 and Wellington, where river waters enter the Lower Lakes, has also been substantially modified. In this section low lying marshes and wetlands were drained, with the Murray River bank built up by levees as part of land reclamation for agriculture. This allowed reclaimed areas of farmland to be irrigated using natural gravity, as the river in effect became perched with the construction of banks and thus at this point the Murray is a 'perched' river, higher in elevation than the surrounding farmland.

The Living Murray Foundation report describes:

> "The River Murray estuary would have naturally offered a wide range of fresh, brackish, saline and hypersaline systems (Newman 2000). The Lakes would have fluctuated in level over a range of about 0.0 – 00.5m AHD (Australian Height Datum) giving water depths in average hydrological years of 1-2m (Newman 2000).[43]
>
> "Salinity would also have varied with water level. There would have been a natural interchange of water between the Lower Lakes and the Coorong/Goolwa channels and the Southern Ocean. As well as water exchanging through the main deep channels, flow would also have passed through the smaller and more elevated channels on Hindmarsh, Tauwitchere and Mundoo Island." [43]

'Securing the Future, a long-term plan for the Coorong, Lower Lakes and Murray Mouth' states when referring to the Lower Lakes salinity suggests that salinity 'used to be less than 1000 EC units' (suitable for stock, domestic supplies and irrigation).

This section does not suggest an **average** salinity figure or specifically identify the basis or timeframe of 'used to be less than 1000 EC' . The report also, notes that typically salinity in the Lower Lakes varies between 400 EC to 2,300 EC.[13]

This report further identifies that in 2010, 'the current readings are more than five times, that levels, in Lake Albert, salinity levels are more than 10,000 EC, and are likely to increase unless freshwater can be made available'. (seawater = 60,000 EC units). Reference is also made to the current drought, where Lake Alexandrina reached 6,430 EC and 35,100 EC in the Goolwa channel.

[43] Living Murray Foundation report

[13] Government of SA – Securing the Future CLLMM

During the recent extreme drought in the Basin, in September 2009 the South Australian Government, Department of Water, Land and Biodiversity Conservation – River Murray Water Resources Report (issue 45:4 September 2009) noted that despite lower than minimum entitlement flow (ie 1,800 ML/day as compared to 4,500 ML/d) "**salinity levels <u>above</u> Lock 1 remain fairly low"**. However downstream of Lock 1 salinity levels remain high due to low water levels. Average salinity in Lake Alexandrina is currently 5,400 EC. Average salinity in Lake Albert is currently 8,875 EC."

These salinity figures reflect that the Murray River itself remained relatively low above lock 1, (September 09) but salinity levels rose in the Lower Lakes as under drought conditions the remaining pooled water evaporated.

In the modified Lower Lakes environment created by the barrages, salinity is influenced by salt contents of Murray River water, but a strong factor, is the presence of historical regional marine salts, natural saline groundwater flows, salt spray borne by winds, saline contributions from localised Lake inflows eg Finnis & Currency Rivers, natural sea water seepage from the Southern ocean under the barrages and deep below the sand dunes barriers, that form the natural boundary to the Southern Ocean.

Salinity in the Coorong has been identified as a major environmental issue and hyper salinity in the Southern Lagoon of the Coorong has been used as an indicator of overall Murray River environmental decline.

The Southern Lagoon of the Coorong was included in the broader region - Coorong, Lower Lakes, Murray Mouth wetlands of significance and the resulting listing under the International Agreement for wetlands of significance under RAMSAR in 1985.

At the time the site was included as an Australian recognized site under Ramsar, the Southern Lagoon was specifically noted as Hyper Saline and this is reflected in the management plan.

> 'Pre European salinities in the Coorong's South Lagoon were typically 8,300 EC to 58, 333 EC. European settlement of South Australia and the Murray-Darling Basin has led to greatly reduced freshwater inflows to both ends of the Coorong. Construction of the South East drainage network, which commenced in 1860s, significantly limited flows from the South East. River regulation and irrigation in the Murray Darling Basin reduced flows into the northern Coorong. Southern Lagoon salinities of less than seawater have not been recorded since the River Murray floods of 1974-75. When the CLLMM site was listed as a Wetland of International Importance in 1985, the typical salinity range in the South Lagoon had risen to between 90,000 EC and 230,000 EC.' [13]

Salinity records on the Murray River at Morgan, reflect that salinity levels remain within World Health Organisation (WHO) raw drinking water standards of 800 EC. This is consistent with the targets of the Murray Darling Basin 1987 Salinity and Drainage Strategy (800 EC).

[13] Government of SA – Securing the Future CLLMM

Higher salinity readings in the lower Lakes and Coorong reflect expectations of a highly modified environment in drought periods. River regulation, despite lower than average flows, did not impact on the Murray River salinity readings at Morgan.

The CLLMM site, has increased salinity levels during the Millennium drought, but the higher salinity levels are consistent, with historical drought scenarios.

Carbon plantations

When Australia signed the United Nations Conference on the Environment & Development in Rio de Janeiro in 1992, natural resource policies were framed by a new set of objectives and management approach.

The UN Framework Convention on Climate Change was established in March 1994.

In 1997 Australia signed but did not go on to ratify the Kyoto Protocol. International negotiations enabled inclusion in the Kyoto Protocol of the Australia clause (article 3.7) which enabled Australia to rely on afforestation and deforestation measures to meet its international treaty obligations, on Greenhouse Gas emissions.

Australia approach to its emission reductions may have long term unintended consequences to the environment. Australia's afforestation policies, may produce perverse environmental outcomes with the full extent yet to be realised. In particular on catchment hydrology and future fire management.

There has been no effective analysis of potential negative environmental impacts from Australia's policy position under Kyoto. The long term impacts on catchment water yields, are not factored into consent provisions or overarching Federal or State Government policy.

A further complication is the contract time frame for Kyoto compliant carbon plantings that have a mandatory life span in excess of 70 years.

Plantation forestry on the scale to meet Australia's afforestation targets was underpinned by Managed Investment Schemes. The financial fallout of Managed Investment Schemes has been well documented in recent times. It is not clear however, the fallout to the environment from poorly planned afforestation targets.

In a published report to Science (American Association for Advancement of Science) in 2005, which included contributions from the CSIRO, environmental risks from carbon sequestration strategies were identified, in particular tree plantations. Research identified that "plantations decreased stream flow by 227 millimeters per year globally (52%), with 13% of streams drying completely for at least 1 year".[1]

As part of a global assessment, '504 annual catchments observations' identified that afforestation substantially reduced stream flow within a relatively short time frame from initial plantings.[57]

The report identified the 'co-benefits and trade-offs of plantation need to be taken into account when negotiating exchange agreements'. The report goes on to say 'decreases in stream flow and changes in soil and water quality are likely as plantations are increasingly grown for biological carbon sequestration'.[57]

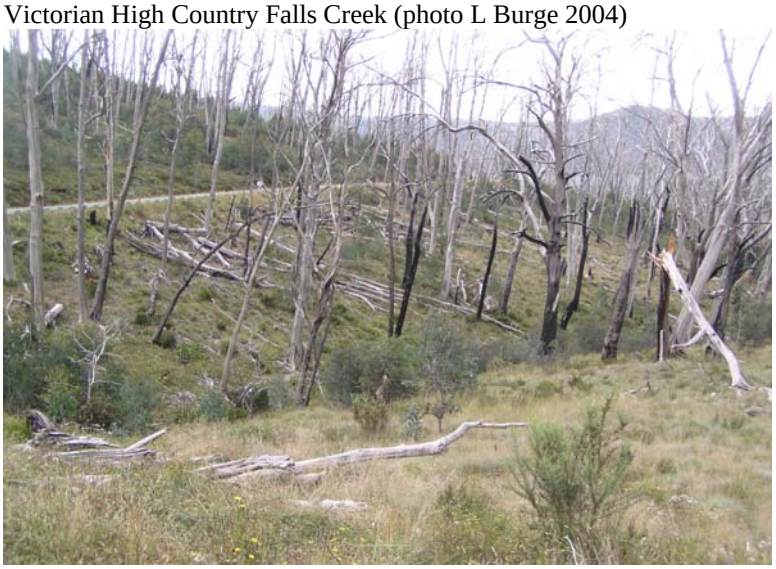
[57] Science AAAS – Trading water for carbon with biological carbon sequestration

It seems short sighted in this era of public and political concern with climate change, that the very policies design to meet emission obligations, could adversely affect long term Catchment yields. This is particularly relevant for the MDBA in assessing the impact of climate change on inflows from the headwaters of the Murray Darling Basin and more localized inflows to environmental asset sites from plantations.

In developing future sustainable diversion limits for the Murray Darling Basin, it is possible to conclude that current forestry interceptions are taken into account prior to determining sustainable diversion limits for existing entitlement holders. It is not clear how future interception impacts will be addressed for future Carbon Plantations.

Bushfires

Victorian High Country Falls Creek (photo L Burge 2004)



Kosciuszko National Park (Photo L Burge Feb 2010)Evidence of 2002 Wildfires

Victoria is one of the most affected States from Bushfires. According to Forest Fire Victoria, 'three quarters of bushfire-related deaths and more than half of economic losses' incur in Victoria.[20]

From the period 1896 to 1945 approximately forty fire seasons experienced bushfires. Major bushfires occurred in 1898, 1905, 1906, 1914, 1926 and 1932.[20]

[20] Forest Fire Victoria: Dexter B; Hodgson A – Facts behind the Fire

Major fires in recent history include:

Victorian Bushfires	Hectares burnt
1939	1,364,410
1942 & 1943/44	160,000
1952	> 100,000
1961,62	100,000
1965	378,000
1983	210,000
2003	1,067,500 forest & 90,000 ha private land

(statistic source: Forest Fire Victoria)

According to the Forest Fire Victoria 'The Facts behind the Fire', a Scientific and Technical Review of the Circumstances Surrounding the 2003 Victorian Bushfire Crisis, fire behaviour in forest fires, will be determined by:

'The amount and type of accumulated fuel in the forest;

- Fuel quantity
- Fuel size
- Fuel arrangements and distribution
- Moisture content and curing of living plant tissue
- Moisture content of dead or cured material; and
- Fuel availability

Fire weather:

- Climate – the prevailing weather over a significant period of time
- Weather – local and regional; the condition of atmospheric elements such as atmospheric pressure, temperature, humidity, wind and stability, vertical motion and turbulence of the atmosphere'

This report stated that the 2003 Victorian Alpine fires were different to past fire events. The intensity of the fires scorched 53% (527,100 ha) of all the trees, either severely scorching their crowns or incinerating their crowns.[20]

It is estimated that previous wildfires would not have resulted in such extensive tree losses, particularly since European settlement.

In recent decades, there has been a fundamental shift in management of Australian native forests, with a corresponding build up of fuel sources. This continues to be a vexed issue for future fire risks.

Forest Fire Victoria report refers to "Mr. Pat O'Shaughnessy's preliminary estimate of the total area of alpine ash forest destroyed is about 73,700 ha". The section of the report referring to the alpine ash forest (73,700 ha) further identifies that the total losses in water yield over 64 years equates to 195ML/hectare or 14.4 million megalitres. An average of 225,000 ml/year.[20]

[20] Forest Fire Victoria – Facts behind the Fire

The report notes when referring to the sample of 73,700 alpine ash impacted by the fires, that there will be initial runoff of 184,000 Ml/yr that would drop off to 313,000 ml/y by year 17, still delivering a total loss of 221,000 Ml/y.

In the period of the inquiry and report on the Victorian Alpine fires, Journalist Peter Hunt (Weekly Times 11.8.04) reported that:

> "CSIRO Land and Water Chief Rob Vertessy said water run-off from the forests would fall significantly, leading to a review of entitlements under the National Water Initiative". "Its pretty certain there will be negative impacts in the next 10 to 20 years," Dr Vertessy said. "We're talking about large reductions in yields".[20]
>
> The Murray Darling Basin Commission former CEO, Mr Don Blackmore, also forecast a significant reduction in water yield during the next 20-50 years.[20]
>
> "The Director of Australia's Co-operative Research Centre for Catchment Hydrology, Roger Grayson said run-off from the burnt-out forests could drop by 20 to 40 per cent I the next 10 to 20 years. Professor Grayson has been commissioned by the Murray Darling Basin Commission and Victorian Government to determine the impacts of the fires".[20]

In planning for the environmental and social and economic needs of the basin, it is imperative for the MDBA to take a broader long term view of the range of policy decisions in Australia that will cumulatively impact on long term inflows.

This includes, the design of Australia's future Emission Trading Scheme and the extent of future carbon forestry plantations and the long term environmental management policies for the natural Forests in the headwaters of the Murray Darling Basin (NSW and Victoria).

Under climate change predictions, it is argued that temperatures will increase and rainfall will decrease, particularly in the Southern part of the Basin. Under this scenario the increasing plantations in the catchment and the changed management scenarios of crown forests to conservation reserves will impact on future catchment hydrology.

(note: during consultation, it was identified that the MDBA is aware of reduced inflows resulting from extreme wildfires, but has made no provision for it in the objectives to increase end-of-system flows)

CONCLUSION

The Murray Darling Basin resources and its communities have evolved due to Federal and State Government investments, planning and recognition of the economic wealth creation that have contributed to Australia's economic prosperity. The ingenuity, economic wealth and Australia's key food bowl is now subject to significant and permanent changes.

In part this can be attributed to meeting revised needs of the environment and perceptions around Australia's international agreements. However, it will also be determined that fundamental changes to Australia's food bowl, have resulted from political reactions during one of Australia's major drought events. In this context the political strategy to obtain a level of power over water - will reshape Australia's key agricultural region.

[20] Forest Fire Victoria – Facts behind the Fire

The MDBA objective to recover water for the environment (minimum 3000 GL) under the Basin Plan, means that 2000 of the 3000 GL is to flow out to the Southern Ocean through the objective to increase end-of-system flows.

To increase end-of-system flows under a reduced future 'inflow' scenario, appears to defy logic. A key reason for such an objective is the need address ecological issues in Lower Lakes, Coorong and Murray Mouth that have a range of contributing causes outside Murray Darling Basin extractions.

There is no recognition by the MDBA of the cumulative risks to inflows from future Bushfire and Forest Management policies.

Future impacts from Australia's policy response to Climate Change under an Emission Trading Scheme has also been ignored. Australia's reliance on offsets in the short term planning period before industry moves to less emission intensive options may lead to long term ramifications on the Murray Darling Basin.

Forestry offsets legal obligations will continue in excess of 70 years and as new science emerges, the contractual framework will ensure, that limited actions, can be taken to reverse impacts on catchment hydrology.

In determining the future environmental needs of the Murray Darling Basin, there needs to be clear distinction between natural drought sequences and the concept of 'over allocation'.

Understanding natural drought sequences are imperative to inform planners when determining additional water to be allocated for the environment. It should be noted that the Murray River continued to flow as reasonable levels and water supply to the city of Adelaide has been maintained during this most serious drought - despite a supposedly flawed and over allocated system.

Therefore, as a baseline point, Australians need to understand what standard or benchmark for the environment is sought. There may be an inaccurate presumption, that re-acquiring water entitlements can drought proof the nation. In reality, water recovered for the environment will not provide more certainty to irrigation supplies, as the environment will become another 'water user', competing with storage space in our major dams.

Despite modern infrastructure such as the Hume and Dartmouth dams, the Snowy scheme and many other dams in the Murray Darling Basin, Australia can never achieve the concept of 'drought proofing the nation'.

The Murray Darling Basin has been subject to significant planning and water reforms to date. This often not appreciated by the wider Australian community. The benefits of a regulated water supply system on the Murray River have delivered multiple benefits to the environment and to the nation.

If Government policies are to substantially change this, then policies should be built on strong foundations.

List of Abbreviations

MDBC	Murray Darling Basin Commission
MDBA	Murray Darling Basin Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEH	Department of Environment, Water, Heritage and the Arts (Australian Government)
GL	Gigalitre (1 thousand megalitres)
ML	Megalitre (1 million litres)
Ha	Hectares
EC	(Salinity) Electrical Conductivity
P.P.M.	(salinity) Parts per million
AHD	Australian Height Datum
M	Metres
CLLMM	Coorong, Lower Lakes, Murray Mouth
RAMSAR	International Convention for Wetlands of Significance (1971)???
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
KM	Kilometres
NRM	Natural Resource Management
COAG	Council of Australian Governments
IGA	Intergovernmental Agreement
NWI	National Water Initiative
SA	South Australia

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